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ANNEX

PHILLIPS'S MINERALOGY.

FIFTH EDITION.

COMPRISING SIX HUNDRED WOOD CUTS.

"The study of Mineralogy, whether it be viewed as tending to increase individual wealth, to improve and multiply arts and manufactures, and thus promote the public good; or as affording a pleasant subject for scientific research, recommends itself to the attention of the citizen and the scholar."—*Prof. Cleaveland.*

AN ELEMENTARY TREATISE ON MINERALOGY:

COMPRISING

AN INTRODUCTION TO THE SCIENCE;

BY

WILLIAM PHILLIPS, F.L.S. M.G.S. L. & C.
HON. MEMBER OF THE CAMBRIDGE AND YORKSHIRE PHILOSOPHICAL SOCIETIES.

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FIFTH EDITION,

FROM THE FOURTH LONDON EDITION, BY ROBERT ALLAN:

CONTAINING THE LATEST DISCOVERIES IN

AMERICAN AND FOREIGN MINERALOGY;

WITH NUMEROUS ADDITIONS TO THE INTRODUCTION.

BY FRANCIS ALGER,
MEMBER OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, OF THE NATIONAL
INSTITUTE FOR THE PROMOTION OF SCIENCE, OF THE BOSTON
SOCIETY OF NATURAL HISTORY, ETC.

WITHDRAWN

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PREFACE.

When I first commenced this work, my intention was merely to add to the deservedly popular Treatise of the late Wm. Phillips, the principal localities of North American minerals, and such new species as I could conveniently gather from the few journals within my reach, and to send it forth as a still later edition of that work. Professor Cleaveland's Mineralogy having been long out of print, there had been for some time an urgent call in this country for an elementary system like Phillips's, based on a chemical arrangement, and illustrated by numerous figures of the primary and secondary forms of crystals; and I supposed that in three or four months, I could make the additions proposed, and, to some extent, answer this call. As Dr. Thomson's work was more recent, my *first* intention was to republish his first volume, by adding to it a short introduction on Crystallography, and embodying as many of the figures from Phillips's as possible. But I relinquished this idea, on learning that Prof. Webster, of Harvard University, had been engaged in the same labor, and had actually prepared a volume on the basis of Dr. Thomson's and Phillips's, which was even publicly announced as in the press. From the apprehension that two works were not required, I was unwilling, finding also that the publisher declined proceeding in the undertaking, to engage in either, until, after repeated inquiries, I learnt that the publisher who had announced Dr. Webster's work as in press, had suspended its publication; and, eventually, that there was little prospect of his proceeding with it. The pressing calls for a work of this character throughout the United States, finally led me to the preparation of the present volume. But I soon found that to make the additions proposed, without embodying a more complete view of the chemical constitution of the species, their atomic formulas, &c., would be but a very imperfect exposition of the present advanced state of mineralogical science. It occurred to me that the value of Phillips's Treatise, would be greatly enhanced, by introducing generally the symbolic characters, and the mineralogical formulas, adopted by Dr. Thomson. To effect this, it became necessary to rearrange the introductory sections on the metals and other simple bodies, and to express their atomic relations to each other, according to the system of equivalents which had been arrived at by the investigations of Drs. Thomson and Prout. The explanatory remarks at the close of the Introduction, render it unnecessary to repeat the reasons why these atomic weights have been preferred. They have been also introduced, in a tabular form, with familiar illustrations of their uses, for the benefit of the student. It will be observed that they generally agree with the numbers obtained by Berzelius, if multiplied by ten ; and, consequently, the mineralogical formulas founded on the same analyses, will be the same whether we adopt one or the other ; that is, simply divide by the smallest numbers, or calculate from the quantities of oxygen contained in the several constituents, as has also been explained in the Introduction. Hence a large number of Dr. Thomson's formulas, agree with Beudant's ; the discrepancies generally arising from arbitrary considerations, having reference to their essential and non-essential constituents. The formulas given by other authorities, also vary in the same manner, so that we sometimes have two or three for the same mineral. Chemical formulas have occasionally been given, when employed by the analysts themselves, or in stating the composition of some of the more complex species, particularly of the metals ; but for the purposes of mineralogy, they should not be generally introduced to the exclusion of the mineralogical signs, which answer all the ends desired in making known the proximate constituents of the species, and do not involve a knowledge of chemistry beyond that which most students should possess. Much may, however, be said in favor of adopting the plan so well carried out by Beudant, of employing both formulas.

Besides the changes thus alluded to, it seemed necessary to treat of some subjects most essentially connected with the science, which had either not been fully or adequately discussed, or had been entirely omitted. I allude to Crystallography, and to the doctrines of Pseudomorphism, Isomorphism and Dimorphism. Of these last, but little was known when the late Mr. Phillips prepared his last edition ; but they were subjects familiar to Mr. Allan, and certainly should not have been entirely overlooked by him. They have been now treated of, perhaps with as much copiousness as is desirable ; while the Crystallographical part, has been enlarged by the addition of many new figures, and the leading definitions and elementary principles of this department of the subject. These are founded on the Popular Introduction to Crystallography, by Brooke, whose system of notation and primary forms, first adopted by Phillips, has been followed, the new figures of crystals now introduced, being lettered and drawn in accordance with them. It is undoubtedly the simple, unmathematical method of acquainting the student with Crystallography, as made known in the writings of Brooke, and first practically exemplified by the numerous diagrams scattered through the successive editions of Mr. Phillips's work, which has conferred upon it a popularity altogether unequalled by any other treatise on the subject. His accurate measurements of crystals, sometimes confirming, and often disproving, the previous, more mechanical, determinations by Haüy, and which are given so extensively in this volume, have rendered his labors in mineralogy of invaluable service to other authors who have since published. This was his peculiar province, and he has acquired in it a pre-eminence which will ever identify his name with mineralogy.

In the general arrangement of the Descriptive part, I have made no changes. A few species have occasionally been transferred from one class to another, in consequence of newer and more accurate analyses; and in some instances, for the same reason, substances described as distinct species, have been united with others; or introduced only as varieties. Some of these last are the following: Nacrite has been united with Talc. (Brunswick, Me., Nacrite with Mica): Xanthophyllite with Clintonite, or Seybertite, according to Prof. G. Rose; Wollastonite and Stellite of Dr. Thomson, and Pectolite of Kobell, with each other, under the name of Stellite: Okenite of Kobell, with *Dysclasite* of Connell: Harringtonite of Dr. Thomson, with Mesole; Scolezite with Mesolite: Spinellane with Hauyne: Pleonaste with Spinelle; Meionite with Scapolite; Humboldtite of Lévy, with Datholite: Phillipsite of Beudant, with Purple Copper; Neoctese of Beudant, with Scorodite: Fibrolite with Kyanite: Xenolite of Nordenskiöld, with Bucholzite: Junkerite of Dufrenoy, with Spathose Iron: Beudantite of Lévy, (as shown by MM. Damour and Descloizeaux) with Pharmakisederite: Cyprine with Grossularite, as shown by the analysis of Richardson; Beudantite of Monticelli and Covelli, with Nepheline; Mellilite with Humboldtilite, as shown by M. Damour. The number of these might perhaps at the present time be considerably increased. For example, Brooke and Tamnau, have shown the crystallographical identity of Phacolite with Chabasie, though Breithaupt maintains the distinction, and the analyses by Anderson and Rammelsberg, are not decisive on the point. Rammelsberg's recent analysis of Comptonite compared with Thomsonite, also shows an exact agreement in the atomic constitution of these two minerals, yet their crystallographical identity is not fully admitted. Of American species, Chlorophyllite of Jackson, is classed with the Hydrous Iolite of Bonsdorff; Washingtonite of Shepard, with Ilmenite; Stellite of Beck, with Stellite of Dr. Thomson, under the name of Anhydrous Lime-Mesolite; Bisilicate of Copper of Bowen, with Chrysocolla; Microlite of Shepard, with Pyrochlore; Beaumontite of Lévy, and Lincolnite of Hitchcock, with Heulandite; Eremite and Edwardsite of Shepard, with Monazite; Eupyrchroite of Emmons, with Phosphate of Lime; Pickeringite of Hayes, with Magnesian Alum; Danaite of Hayes, with Mispickel; Chiastolite with Andalusite; Boltonite of Nuttall, with Picrosmine; Rensselaerite of Emmons, with Pyroxene.* All the additions by Mr. Allan have been retained, with the exception of the Table of the Composition of Species, which was rendered unnecessary by the substitution of the formulas. They are credited to him as quotations from his "Manual," so far as they are thus distinguished in his edition; but in numerous instances, fresh matter has been interwoven with them, as it has been throughout the work. These freedoms with the author's text, were rendered necessary by the impracticability of introducing so large an amount of matter in the form of notes. A few notes, however, were unavoidable; these, when written by Phillips or Allan, are so indicated. For the rest, the present editor is responsible.

The matter now introduced rather exceeds three hundred pages. It comprises over one hundred additional figures in the Introduction, and the Descriptive part; with the new species, foreign and American, brought into notice since the date of the last edition; and the addition of many foreign, as well as all the important American localities. The last have been gathered from various sources, but principally from the State Reports, by Profs. Hitchcock, Beck, Emmons, Shepard, W. B. and H. D. Rogers, Drs. Troost, Jackson and Haughton. The localities in Nova Scotia, have been given from the personal observations of Dr. Jackson and the editor.

While several minerals, supposed to be new, have been united with others, but one new species has been proposed, viz. Hayesine, or Borocalcite, described at p. 318. One or two changes have been made in the naming of species, which seemed to be demanded by a simpler or more characteristic expression of their distinguishing properties. Thus the Uniaxial Mica, which differs from the Biaxial species, in containing Magnesia, I have disinguished as Magnesian Mica. The two prominent species of Iron ore, the Magnetic and Specular, *both of which* are known to be magnetic, have been more appropriately designated under the names of Pleisto-Magnetic Iron, and Oligisto-Magnetic Iron. Red Hematite, and one or two other varieties of iron ore, hitherto included under the last species, with which they have little affinity, have been transferred to the species Limonite, which also comprises Brown Hematite, Goethite, and Stilpnosiderite, hitherto described in this work as distinct species.

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* For authorities in these cases, as well as most of those cited on the last page, the reader will refer to the articles themselves.

In the preparation of this work I have consulted the various treatises on the science, the numerous Reports of our own Mineralogists and Geologists, who have been called into the field by the various State Legislatures, as well as our Scientific Periodicals, and the Transactions and Journals of various Scientific Societies. To the *American Journal of Science*,—that most invaluable repository of all the discoveries in American mineralogy during the last twenty-five years,—I am particularly indebted for numerous statements and facts presented in the following pages. Dana's Latin names have been introduced along with many other additional synonyms, particularly those by Prof. Jameson. The principal foreign sources from which some of the most important additions have been obtained, are the *London Edinburgh and Dublin Philosophical Magazine; Jameson's New Edinburgh Journal of Science; Brewster's Edinburgh Journal of Science; Thomson's Records of General Science; the Reports of the British Association; the Transactions of the Royal Society of Edinburgh, and of the Geological Society of London; De la Beche's Report on Devon, Cornwall, &c.; and Brooke's article, Mineralogy, in the Encyclopedia Metropolitana.* Berzelius's Annual Reports, (usually the French or German reprints,) have been largely consulted, as have also the principal French journals, the *Annales de Chimie et de Physique*, and the *Annales des Mines; Journal für praktische Chemie; Poggendorf's Annalen der Physik und Chemie; Kongl. Vetenskaps Academiens Handlingar; Verhandlungen der Kaiserlich-Russischen Mineralogischen Gesellschaft zu St. Petersburg*, 1842. The other sources of information have been acknowledged in the body of the work. The Chemical Mineralogy by Rammelsberg,* (2 Vols. and 1st Supp.,) a most thorough and laborious treatise, comprising all the important analyses of mineral species hitherto published, has often been consulted;

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* *C. F. Rammelsberg. Handwörterbuch des Chemischen Theils der Mineralogie*, in 2 vols. 8vo. Berlin, 1841. *Erstes Supplement, &c.*, 1 vol. 8vo. Berlin, 1843.

I have only to regret that I was unable to obtain a copy of this k, until a considerable part of the present Treatise had been printed. y the obliging courtesy of Charles Cramer, Esq., late Secretary he Imperial Mineralogical Society of St. Petersburg, I have re- ed copies of the Transactions of that and a similar body of the active ntific men of Russia, of whose labors frequent mention has been e. I am indebted to other friends, for several valuable journals, orks, on the science, which have supplied important information. ong these I would here mention Dr. Feuchtwanger, of New York, ph A. Clay, Esq., of Philadelphia, Saml. L. Dana, Esq., of ell. Of those gentlemen, who have supplied me with many valua- acts, or have given me their friendly advice on many occasions, I ld also mention the names of Dr. C. T. Jackson, A. A. Hayes, . Teschemacher, and Prof. J. W. Webster. I am indebted to wo first named gentlemen, for the analyses of several minerals, results of which were first communicated to this work The yses of Stellite, Sillimanite, Washingtonite, and Acadialite, were ingly undertaken by them at my request, and were instituted on very pure crystals, which I had placed in their hands.

rom Mr. James H. Blake, I have received very valuable notices l the localities discovered or visited by him, during his late tour ugh the rich mineral districts of South America: he has besides lied me with several new analyses. My obligations are particu- due to J. E. Teschemacher, Esq., for the measurements of the

INTRODUCTION TO MINERALOGY.

PART I.

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PREFACE TO THE THIRD EDITION.

The present differs from the preceding edition in some respects, which appear to require notice in this place.

The most important additions and improvements that have been made, consist, *first*, in the introduction of notices or descriptions of about eighty minerals, of which the greater part have been discovered since the publication of the preceding edition; *secondly*, in the insertion of the results obtained by a careful examination of most crystalline minerals, as regards their structure and cleavage; *thirdly*, in the addition of a figure to the verbal description of most substances found in a crystallized state, representing the primary form, and another the secondary planes in connection with those of the primary crystal, together with such measurements of the planes as I have been able to obtain, chiefly by means of the reflective goniometer of Dr. Wollaston; *in the fourth place*, advantage has been taken of a translation of Berzelius's excellent work on "The Use of the Blowpipe in Chemical Analysis and the Examination of Minerals, by J. G. Children, F. R. S. L. & E. &c." in so far as relates to the more simple experiments

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In regard to arrangement, no alteratio
edition, except where new and more sa
manded a change: on the subject of the
it seems requisite only to add, that, havi
adopted it as being in my own estimation
to the student that I could devise, the ex
now induces me to recommend it to h
method of placing the minerals in his cat

In pursuing the at once pleasant and lab
connected with the important characters of
form, and measurement, and which were
view of rendering the present edition mo
student, it will be imagined that I have m
information; and, although some new fac
points have resulted, it must be acknowlec
remains for future investigation.

If the more accomplished mineralogist sh
consult this little work, he will perceive tha
of the crystalline forms, and especially of th
are not precisely exact, do not on all occasio
for in no instance has it been attempted to c
of nature by a resort to the more rigid laws
has been ascertained, by a comparison of
taken from similar and brilliant planes of
that, owing to some natural inequality of su
cise angle is rarely obtained, and hen

considered only as near *approximations* to the true value; but where those of the primary form have been obtained from planes produced by cleavage, which is generally noted, when that is the case, in the description of the mineral, they may be considered as approximating the truth much more nearly than when taken by means of the natural planes. A considerable proportion of the whole will perhaps be found sufficiently precise to form a basis for the calculations of the mathematician, and, together with the accompanying figures, to induce the student to examine the forms of crystals, and to delineate and measure the angles formed by the meeting of the planes by which the crystals in his own cabinet are bounded. If errors should be found in the following pages, greater than those above alluded to, they are to be attributed to my own want of exactness in noting the measurements obtained; for, although much care has on all occasions been taken to select the smallest and most brilliant crystals, and to note the results faithfully, it is scarcely to be hoped that errors of this nature have altogether been avoided.

It may perhaps be concluded that, by adopting at once the figures and measurements given by Haüy, and other mineralogists, much chance of inaccuracy might have been prevented. But it must be observed, that where the primary form is not a regular geometrical solid, such as are the cube, regular octahedron, and six-sided prism, the means resorted to for determining the true measurements — namely, that of subjecting the planes obtained by cleavage to the reflective goniometer — is a more certain method than that adopted by Haüy; and it will be perceived that a very large proportion of all the primary forms are not regular geometrical solids, such, for instance, as the oblique and doubly oblique prisms, and the very numerous class of rhombic prisms. Where the cube, regular octahedron, six-sided prism, and other regular solids, are the primary forms, I have adopted the measurements given by Haüy, acknowledging them in all cases by annexing the letter H, or by some other mode; first, however, verifying them in most cases by the reflective goniometer. In a very few instances, the authority of the Comte de Bournon has been resorted to, but not without acknowledgment. It will of course be understood that where no authority is mentioned, the measurements have been obtained by the reflective goniometer, and, from what is said above, that they must be considered only as approximations.*

In regard to the figures to which the measurements are annexed, it may be observed, that these are not in all cases the representatives of single crystals, for in some of them are associated the planes observed on two or three; thus occasionally rendering the form more complicated than any single crystal I have seen, but not more so than may probably be found hereafter. This mode has been adopted, as offering to the student the greatest assistance that I could devise, since it combines at one view all the observed planes, without increasing enormously the bulk and consequent expense of the work, as must have been the case if all the varieties of form had been given separately. As to the drawing of the figures, it remains to be added, that they are not given as the result of a laborious execution by the assistance of the rules of geometrical projection; but, in the general, only as diagrams, wanting the precision which in that case might have been claimed for them, and drawn without any other rule than such as the hand and eye could furnish.

The letters on each plane of the larger figures have been so placed, according to the *system of notation* adopted in the "Familiar Introduction to Crystallography, &c., by H. J. Brooke, F. R. S. &c.," a work which may, without hesitation, be recommended strongly to the student, as being calculated to teach the interesting science on which it treats in its most pleasing form, and of which the first part is so simple that, without any reference to trigonometry, geometry, or algebraical calculation, it shows, by means of the figures of crystals and attendant explanations, the position on the primary forms of every secondary or modifying plane to which those forms are liable, and thereby the transitions of one form into another; and here, if he be so inclined, the student may stop, after having gained all that a purely mechanical view of the subject will afford him, or he may proceed to the second part, in which crystallography is treated more scientifically; and it may be added, that the pupil may, in either case, attain such a knowledge of it, as will not fail to open to him new sources of delight in this interesting department of Mineralogy.*

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* In some, though comparatively few instances, the crystals of a substance have not been found sufficiently bright for the use of the reflective goniometer; the common goniometer has then been resorted to, and the measurements taken by it are always distinguished by having the letters *c. g.* annexed to them. [P.]

To the author of the fore-mentioned work I am under much obligation, for assistance on various points connected with the improvements which it is confidently hoped will be manifest in the present edition. Often as his name occurs in its pages, I have been yet more often indebted to him, not only for the loan of specimens, amongst which were several that I could not otherwise have obtained, but for assistance in the clearing up of many difficulties which, without his help, would have been left in doubt, or would have terminated in error.

My acknowledgments and thanks are also thus publicly due to several others of my friends. To Thomas Allan, F. R. S. L. & E. for many useful criticisms, of which I have not failed to avail myself, as well as for the liberal transmission from Edinburgh of some rare and valuable minerals. To Ashurst Majendie, M. G. S. for the loan of well-defined crystals of several scarce substances. To Samuel Luck Kent, M. G. S. for a free access to his cabinet upon all occasions, and for his cheerful permission to avail myself of the advantage in any manner that might tend to benefit the work, and even for the presentation to me of some rare substances. To Henry Heuland, For. Sec. G. S. for some valuable minerals presented to me in a manner consistent with his well-known liberality; a liberality which also I have experienced in numerous instances from G. B. Sowerby, F. L. S. to whom likewise I am greatly indebted for many valuable hints, and for the readiness with which he has upon all occasions endeavored to promote my views.

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* It is to be hoped that the distinguished author, above alluded to, will soon cause to be issued a new edition of his work, which is now most eagerly demanded by mineralogical students. [Am. Ed.]

In conclusion, if the utility of a nice investigation of the *structure* of crystallized minerals, and the *measurement of their angles*, should become an inquiry, it may be replied that they often determine the differences existing between minerals which greatly resemble each other. This, as is observed more at large in the following "Introduction," is fully exemplified in the differences discovered by means of the reflective goniometer, between the measurements of the primary rhomboids of carbonate of lime, carbonate of lime and magnesia, and carbonate of iron; minerals which often so greatly resemble each other, that the difference between them can only be ascertained by a resort to chemistry, or the reflective goniometer. The utility of a close attention to this instrument has been further manifested since the foregoing was written, and in a very remarkable manner: — A mineral which has always been considered as bitterspar from the Tyrol, and of which the primary crystal is a rhomboid not distinguishable by the unassisted eye from that of either of the foregoing, was found by the reflective goniometer to afford measurements different from them all; the cause of this became manifest by a resort to analysis, which proved it to be a new compound, namely, a carbonate of magnesia and iron. The reflective goniometer is moreover of great use to the geologist, who finds those rocks which are termed primitive, and many of those which are called transition, or the oldest secondary, to consist, not of one homogeneous mass, as is often the case with those of a newer origin, but of two or more minerals, so intermixed and associated that a reference to the chemist is of little avail to him: by such means he may indeed become informed whether a particular earth or alkali is to be found in the mass, but the various substances of which it is compounded are often too minute, and therefore too intimately associated with the others, to allow of a determination as to which of the component substances may contain the earth or the alkali so discovered. Hence structure, if it exist, becomes a character of essential importance; for it will be found that fragments far too minute for analysis will often afford brilliant planes, well adapted to the use of the reflective goniometer. A knowledge of structure, therefore, and of the measurements of the primary forms of minerals, is very important to the geologist; but where structure does not exist, the examination of the various external characters of the minute portions forming the aggregate of the rock are often of singular advantage; and hence the geologist should become intimately acquainted with the external characters of at least all such substances as are found entering into the composition of rocks. Mineralogy, therefore, is in reality essential to the geologist; it is the very *alphabet to the older rocks*, and it is probably to be attributed in great measure to the want of due preparation for the study of these rocks, by an intimate acqaintance with minerals in the *simple* state, that the primary and transition tracts of England and Wales have been investigated in a far less degree than those of a newer origin.

"It has been said of crystals," says the Abbé Haüy, "that they are the flowers of minerals; an observation concealing a very just idea beneath the air of a comparison which appears to be only ingenious." The importance of "*form* will become more evident," he further observes, "if, in pursuing our inquiries into the niceties of the mechanism of structure, we conceive all these crystals as the assemblages of integrant molecules perfectly resembling each other, and subject to the laws of regular arrangement. Thus, although by a superficial notice of crystals we might adjudge them to be only the sports of nature, a more intimate acquaintance with them leads to this conclusion, — that the Deity, whose power and wisdom prescribed the unerring laws of the planetary motions, has also established those which are obeyed with the same fidelity, by the molecules composing the various substances concealed in the recesses of the earth."

MAY 10, 1823. W. P.

EXTRACTS FROM THE PREFACE TO THE SECOND EDITION.

[I have thought it proper to introduce a few paragraphs from the preface to the second edition of this work, because they have a beautiful, and, even to this day, not untimely application to the whole subject, and are well calculated to excite the interest of the student in the pursuit of an ennobling and invigorating science. The closing words of both prefaces are characteristic of what was the pervading spirit and purpose of the excellent author.]—*Am. Ed.*

The most effectual and advantageous method of acquiring a competent knowledge of minerals, is undoubtedly that of personal instruction. The superiority which France and Germany have attained in mineralogical science, is in great measure to be attributed to the facility of obtaining instruction, both public and private.

Mineralogy, as it is too commonly pursued, is made to consist more in the recognition of minerals than in the knowledge of what may be termed its principles; — more in the possession of specimens, and in that satisfaction which arises from arranging them in their places, than in subjecting them to those investigations which, when once they are attempted, are found to constitute the real value and even the charm of the science. The beginner may be assured that it is replete not less with entertainment than with instruction; for whether the observation of the physical characters — of structure, phosphoresence, or electricity — or whether the blow-pipe, or those investigations which belong to chemistry, may be most congenial to him, each will be found to possess an ample source of gratification, in the instruction which curious phenomena never fail to convey to the mind, and in the exertion of the ingenuity required for their development.

It may be assumed that the physical characters of minerals are more likely to interest the generality of students, as being more obvious, and probably more consonant with their general pursuits, than the chemical characters. Of the physical, structure will be found the most inviting and most uniform, and therefore the most important of them all. The manner in which it is treated of in the Introduction, being purely mechanical, is not likely to satisfy the advanced mineralogist, for whom indeed it is not designed; but perhaps may interest the student sufficiently to induce him to pursue the subject still further; and what if I say, to tempt him to complete his acquirements by a resort to the works of the Abbé Haüy, in which he will find structure, and its interesting and beautiful consequence, regular external form, illustrated by the application of the mathematics to its laws.

The catalogue of simple substances offers to our notice some striking considerations, when viewed as including, according to the present state of our knowledge, all the component materials of the crust of the globe. This crust, however, is primarily constituted of earthy compounds, in which only two or three of the metals are found either intermixed, or in a state of combination; for the metals and metalliferous ores principally occur in the veins which traverse mountainous or hilly countries, and their quantity, as compared with that of the rocks which enclose them, sinks into insignificance. The alkalies occur in too trifling a proportion to be of much consideration in this point of view; and the acids, excepting the carbonic, and their bases, excepting perhaps only carbon, are similarly circumstanced. But if we would look still more narrowly into the composition of the crust of the globe as consisting chiefly of the earths and earthy minerals, we shall find that only three of the ten earths which have been discovered, namely, silica, alumine, and lime, are found to constitute its great bulk; for although magnesia is a constituent of a mountain rock, it is by no means plentiful, nor does magnesia enter into its composition in a large proportion. The other earths are found only in comparatively small quantity, and chiefly, if if not altogether, in veins.

If, however, we pursue the investigation further, we shall find that the three earths above mentioned are compound bodies, consisting on the average of about 50 per cent. of oxygen, combined with the bases, silicium, aluminum, and calcium, in the proportion also of 50 per cent. in the aggregate.

Now if we turn our attention to what is known of the nature of these four elements, oxygen, silicium, aluminum, and calcium, which primarily constitute the great mass of the crust of the globe, some curious facts will be presented to our consideration. The first and most abundant element, oxygen, has eluded the vigilant eye of the analyst, being known to him, in its purest state, only in combination with caloric, as a gas; — silicium and calcium, although they may have been rendered visible, can scarcely be said to have been seen in a separate form, and hence their precise nature is unknown; — while calcium has been observed to possess the color and lustre of silver; but as it spontaneously takes fire the instant of its exposure to the air, its nature has not been examined.

It is admirably observed by my friend J. G. Children, that "with four simple elements (oxygen, hydrogen, carbon, and nitrogen, a brief alphabet for so comprehensive a history) has a bountiful Providence composed the beautiful volume of the *living world;* where, turn to what page we may, fresh loveliness meets the eye, fresh cause of admiration and delight." (Essay on Chem. Analysis, p. 271.)

That part of the creation, therefore, which is *animate*, is composed of some of the same elements as the *inanimate:* and, according to the present state of our knowledge, the elements employed by the great Artificer of the Universe, in the formation of the globe, and all the animal and vegetable creation, but little exceeds the number of fifty, reckoning as elements some substances which are suspected to be compounds. And when we reflect upon the fact, that a very few of these actually constitute a very large proportion of the whole; — upon the nature of these elements, that several, even of those which have been employed in by far the most important degree, have either eluded our research, or are known to us chiefly by their agencies — upon their wonderful arrangement, subservient to the purposes of organization in the living, and structure in the inanimate; upon the affections and properties of matter in general, we may adopt the language of the Abbé Haüy, and say that Nature is thus exhibited " under an aspect which claims for its Author the tribute of our admiration and our reverence."

MAY, 1819. W. P.

INTRODUCTION.

The investigation of the structure of the earth belongs to the science of Geology. It may, however, be interesting to take a rapid survey of the present state of our knowledge respecting it, were it only for the sake of showing its intimate connection with mineralogical pursuits.

In speaking of the earth, and of our knowledge of its nature, it is essential that the limited extent of that knowledge should always be had in remembrance. We are acquainted with it only to a very inconsiderable depth; and when it is recollected that, in proportion to the bulk of the earth, its highest mountains are to be considered merely as unimportant inequalities of its surface, and that our acquaintance does not extend in depth more than one fourth of the elevation of those mountains above its general level, we shall surely estimate our knowledge of the earth to be extremely superficial; that it extends merely to its crust.

The term "Crust of the Earth," therefore, relates only to the comparative extent of our knowledge beneath its surface. It is not used with the intention of conveying an opinion that the earth consists only of a crust, or that its centre is hollow; for of this we know nothing. The term may not be philosophical, but it is convenient.

The nature of the crust of the earth is most readily studied in mountains, because their masses are obvious; and also because, as they are the chief depositories of metalliferous ores, the operations of the miner tend greatly to facilitate their study.

Mountains are composed of masses which have no particular or discernible shape; or, as is more commonly the case, of strata or beds, either horizontal or oblique, sometimes nearly vertical.

In these masses and beds, different structures have been observed. Some of them are crystalline; that is to say, are composed of crystals deposited in a confused manner, as in granite: or of crystals imbedded in some other substance, as in porphyry. These crystalline rocks contain no organic remains; and, as they are always found beneath, never above, those which do contain them, they are considered to have been of earlier formation, and therefore have been termed *Primitive rocks.*[*]

Other mountain rocks have no appearance of crystallization; but on the contrary, seem rather to have been formed by the mere falling down, or settlement, of the substances of which they are composed, from the solution which contained them. These are always found above, never beneath, the crystalline rocks, and often include abundance of organic remains, both animal and vegetable. The more ancient of these, or such as contain the remains of animals of which the genera and species are extinct, are called *Transition rocks;* the more recent, or such as contain the remains of animals most nearly resembling those now inhabiting our oceans, are called *Secondary*, and *Tertiary;* and of this last Mr. Lyell has made four subdivisions founded on the nature of the fossils.

Primitive and secondary rocks have suffered considerable change and ruin from causes which it is not our present object to notice; and their disintegrated portions, having been formed anew, now constitute that peculiar description of deposit which is termed *alluvial*, or *diluvial*, and which therefore consists of the *debris* of rocks.

But there is still another and a very different kind of rock, abundantly found in certain countries, which may in great measure be considered, like the preceding, as resulting from the ruin of rocks, but from an opposite cause, or by an agent directly the reverse, viz. by fire; constituting those known by the name of *Volcanic rocks.*[†] Many of these strongly bear the marks of heat, and even of fusion; some, on the contrary, offer no evidence of their having been subjected to heat.

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[*] These remarks now require some qualification. Von Buch has shown that granite is not *always* subordinate to the so-called newer rocks, and has pointed out a very remarkable instance in Scandinavia, where this rock occurs in strata between other rocks which contain fossils, and are also traversed by it in veins. Mr. Lyell has also recorded a similar occurrence in the Hartz, where, he says, the granite is mixed with grey-wacké slate, containing organic remains. (Jameson's Edinburgh Philosophical Journal, Vol. xxx. p. 211; Lyell's Geology, Vol. i. p. 66, Philadelphia edition.) [AM. ED.]

[†] The terms volcanic or igneous rocks, seem to be applied by the author to the trap rocks and the masses of modern eruptions of existing or but recently extinct volcanoes,

Lofty mountains composed of primitive rocks usually present rugged and uneven summits, and steep acclivities on the sides, as though they had suffered by convulsion. Such as are wholly or externally composed of secondary beds or strata are less rugged, their summits are flattish or somewhat rounded, and their sides present acclivities more easily accessible.

Both primitive and secondary mountains, more particularly the former, are traversed in various directions by fissures of different dimensions. These fissures are not often empty, but are partially, and sometimes, though but rarely, filled with stony or metalliferous substances. They are termed *Mineral Veins;* and from them a large proportion of the specimens composing the cabinet of the mineralogist are obtained; indeed, almost all such as, from their rarity, brilliancy, or peculiarity of form and combination, possess the greatest attraction for the mere collector.

Mineralogy is a science of such interest that it would be much to be regretted if its real objects and tendency were misunderstood, or suffered to degenerate into an avidity merely for the collecting of what is brilliant or rare. To the attainment of the science of geology, which is intimately connected with agriculture and the arts of life, that of mineralogy is essentially requisite. The study of mineralogy, therefore, does not include only a knowledge of the more rare and curious minerals: there is nothing in the mineral kingdom too elevated, or too low, for the attention of the mineralogist, from the substances composing the summits of the loftiest mountains, to the sand or gravel on which he treads. It is true that the aggregated masses of compound rocks are not arranged in a mineralogical collection; but it must be remembered that each of the substances of which such aggregated masses are constituted, are comprehended in a mineralogical arrangement, and therefore find their places in the cabinet. Granite, indeed, is not to be found there; but its components, quartz, felspar, and mica, are met with in every one.

Thus, then, by the study of what, in opposition to the term *aggregated rocks*, may be termed *simple minerals*, the mineralogist becomes enabled to detect the substance with which he holds acquaintance by itself, when aggregated with others in a

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including the trachites; but geologists now comprehend under the same class the granites and the primitive rocks generally, all of which exhibit, under some of their forms, evidences of their igneous origin; so that no opposite cause can be ascribed to one, which is not applicable to the others; nor can either of them be properly regarded as the ruins of previously existing rocks, but only as the cooled, solidified mass of what before existed in the fluid state. [AM. ED.]

mass; and thus he becomes qualified for the more difficult and more important study of the science of geology, which embraces a knowledge of the nature and respective positions of the masses and beds composing mountains, and indeed of country of every description, whether mountainous or otherwise.

It is not, therefore, or at least it ought not to be, the sole object of the mineralogist to be able to distinguish the several genera and species of mineral substances; nor should his attention be confined to the mere task of recognizing a mineral at first sight, or of being capable of at once assigning it a proper place in his cabinet. He should hold a more enlarged acquaintance with minerals, and with the circumstances attending them, in what may be termed their *native* places; he should know something of the positions they respectively bear towards each other in those places; he should become acquainted with their *relative ages*, deduced from the nature of the rocks in which they are found; their comparative scarcity or abundance; their combinations; the *countries* in which they occur; and their *characters*, both internal and external.

This knowledge, it may be repeated, is the first and requisite step in the science of geology; not that it is essential to this science that every mineral should be accurately known; some are of comparatively little importance in a geological point of view, from their extreme scarcity; but it is essential to become acquainted with simple minerals in the general, because of some of them, many of the vast masses of the earth are composed.

Minerals which are found only in primitive rocks, are said to belong to *primitive countries;* by which name are designated such tracts as are chiefly composed of primitive rocks. The substance in or on which a mineral is found, is called its *gangue*, or *matrix;* when in its natural place or position, a mineral is said to be *in situ;* when this place and position are known, we are acquainted with its *habitat.*

CHARACTERS OF MINERALS.

§ 1. It is one of the first, if not *the* first inquiry of those who are uninstructed in mineralogy, if a specimen, of quartz, for instance, be shown them, how they may recognize it. The reply necessarily is, that it is essential to observe it closely, to study it, to mark with precision its characters; — that as minerals are not organized bodies, their characters are less defined, and therefore not so readily intelligible, as those of such bodies as possess regular organization; — that, in fact, there is no treatise, by a reference to which the beginner is enabled, if he take up a mineral, to arrive at once at a knowledge of its nature;* that, therefore, at present, practical observation is the only mean of attaining this knowledge. It will be of advantage, then, that these characters, and the mode of observing them, should be pointed out.

§ 2. Although long experience and attention give a facility in recognizing minerals by mere inspection, this facility can only be acquired by such means. There are certain minerals which may at once be detected by some simple experiment; that is to say, there exist a few possessing some one character which decides with precision what the mineral must necessarily be, because that character belongs to no other. For instance, there are three substances which often so nearly resemble each other, that simple inspection indicates no difference, even when reduced by cleavage to the primary form. All may be cleaved into obtuse rhomboids, differing from each other in measurement. If the planes of one of them meet at the angles of 105° 5′ and 74° 55′, it is carbonate of lime; if the second measures 106° 15′ and 73° 45′, it is bitterspar; the third, measuring 107° and 73°, is carbonate of iron. But comparatively few substances can be known by so simple a process; some cannot be cleaved with regularity; we must then resort to other characters; and it is frequently only by a comparison of several of these that the desired object is attained. It is therefore essential that the characters belonging to each should be faithfully detailed in describing it, since there is no book to which the beginner can resort, that will enable him to distinguish the generality of minerals with facility.

§ 3. The characters belonging to most simple minerals may be said to be numerous. If its parts cohere, it possesses some degree of *hardness;* by trying its hardness, we may discover the ease with which its breaks, or its *frangibility;* and we may or may not perceive that it possesses a regular *structure;* if the structure be regular, we discover the forms into which it may be divided, and amongst them, that from which all the rest are derived, or its *primary crystal.* These regular forms may be termed the *geometrical characters* of the substance; although, along with numerous others, they are commonly included under the term of *physical or external characters.*

§ 4. These characters are extremely important; but taken alone, with whatever precision they might be given, we should still be far from a competent knowledge of the real nature of the substance examined. For there are substances of which the primary form is the same in each, and which resemble each other so strikingly, in their common physical characters, that it is with great difficulty we can distinguish between them as species, without calling in the aid of chemistry. And again, there are others which do not crystallize at all. This science, therefore, becomes an important auxiliary to mineralogy; so important, that no complete and thorough mineralogical system can be established unless it be based upon chemical principles. And the student who enters upon the study of the science with some previous knowledge of chemistry, will find a delight and satisfaction in his progress which he would fail to experience without it, though he should never prove to be, nor aspire to be, a thorough analytic chemist. We cannot agree with the author of a recent Treatise on Mineralogy, that any system ought to be made, or can be made, so simple as "not to require any, the least, knowledge of chemistry, in order to its being perfectly comprehended in all its parts."[*] The characters of minerals should therefore be treated of under two equally important divisions; viz: *physical* or *external*, and *chemical*. The optical properties are sometimes treated of under a distinct head, but they may be included among the physical characters.

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*The method proposed by Professor Mohs is perhaps the most systematic, and approaches nearer to this desirable point than any other, — more especially as regards crystalline minerals. [E. Ed.]

PHYSICAL CHARACTERS.

§ 5. These characters are numerous, and require to be well defined, in order that the same language may always convey the same definite idea: there exist, however, and often in the same substance, such very nice shades of difference in certain of them, that much at last is necessarily left to experience. The learner will find that, after a laborious endeavor to discover by written description what a mineral is, it will be much more easy to discover what it is not; and at all times he will reap an infinitely greater and more speedy advantage from personal instruction than from books. Such, however, as can resort only to the latter, will find that an attentive observation of the physical characters, and a comparison of them in different minerals, will forward the acquisition of knowledge.

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[*] Shepard's Treatise on Mineralogy; preface to part first. It is from this circumstance of rejecting altogether the guidance of chemistry, added, perhaps, to its hard nomenclature, that the natural history system of Mohs has not met with that reception which the great talents of its author, and of its translator into English, would otherwise have secured for it. The mixed system by Naumann, or the last purely chemical arrangement by Berzelius, founded on electro-chemical relations, seem to lead us to an easier and more perfect acquaintance with the mineral kingdom. It is to be regretted that neither of these works has as yet been translated into English. [AM. ED.]

These characters are comprehended under the following heads:

- External Form, &c.
- Structure — perfectly crystalline.
- Primary Forms of Crystals.
- Mechanical Cleavage of Crystals.
- Secondary Forms of Crystals.
- Measurement of the Angles of Crystals.
- Structure — imperfectly crystalline, and its varieties.
- Fracture.
- Frangibility.
- Hardness.
- Transparency.
- Lustre, — Color.
- Flexibility.
- Double Refraction.
- Touch, Taste, and Odor.
- Streak.
- Powder.
- Adhesion to the Tongue.
- Magnetism.
- Electricity.
- Phosphorescence.
- Specific Gravity.

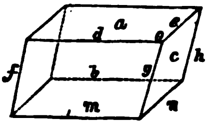
External Form, and Simple Preliminary Definitions.

§ 6. Only a small proportion of the specimens admitted into our collections can be said to possess precise external forms, since they mostly exhibit, on one side or the other, and are sometimes entirely bounded by, surfaces produced by fracture. There are comparatively few minerals which are found in masses absolutely isolated.

§ 7. Nevertheless there are many minerals to which particular external forms belong; some few are found in single or separate *crystals*, and the surfaces of others are coated by them.

A *crystal* may be defined as a more or less symmetrical, geometrical solid, commonly bounded by plane surfaces, which in mineralogical language are termed *planes* or *faces*, as *a*, *b*, *c*, fig. 1.

Fig. 1.



An *edge* is formed by the meeting of two planes, as the line *d*, fig. 1.

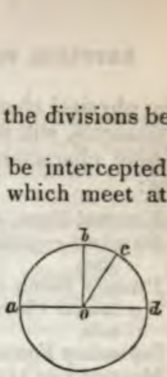
A *plane angle*, or, as it may be termed more simply, an *angle*, is formed by the meeting of any two lines or edges, as *d o e*, *d o g*, fig. 1, which are formed by the meeting of the lines *d o*, *o e*, and *d o*, *o g*.

A *solid angle* is a point formed by the meeting of three or more planes, or *plane angles*, as at *o*, fig. 1.

The value or measure of angles is the number of degrees, minutes, &c. of which they consist.

In measuring angles, the circle is divided into 360 equal parts, called *degrees;* each degree into 60 equal parts, called *minutes;* and each minute into 60 *seconds:* the divisions being thus designated: 360°, 60′, 60″.

If one fourth part of the circle, or 90°, be intercepted by two lines *a o*, *o b*, of the annexed figure, which meet at an angle *a*, *o*, *b*, in the centre, those lines are perpendicular to each other, and the angle at which they meet is said to measure 90°, and is termed a *right angle.* If the portion of the circle thus intercepted be less than $\frac{1}{4}$, as shown by the lines *o b*, *o c*, the angle *b o c* will measure less than 90°; it is then called *acute;* if it measure more than 90°, as it would if the angle were formed by the lines *a o*, *o c*, it is called *obtuse.*



In fig. 1, the plane *a*, and the opposite, on which the figure rests, are called *summits*, or *bases*, or *terminal planes*, and the planes *b* and *c*, with those opposite to, and parallel with them, are termed *lateral* planes.

The edges of the terminal planes, as *d*, *e*, *m*, *n*, are called *terminal edges.*

The edges *f*, *g*, *h*, produced by the meeting of the lateral planes, are termed *lateral edges.*

Planes are said to be *similar*, when their corresponding edges are proportional, and their corresponding angles equal.

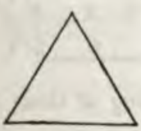
Edges are *similar*, when they are produced by the meeting of planes respectively similar, at equal angles.

Angles are *similar*, when they are equal, and contained within similar edges respectively.

Solid angles are *similar*, when they are composed of equal numbers of plane angles, of which the corresponding ones are similar.

A *triangle* is a figure bounded by three sides, and the sum of its angles equals 180 degrees.

2



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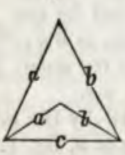

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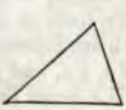

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Fig. 2 is an *equilateral triangle*, or a figure contained within three equal sides, and containing three equal angles. Fig. 3; an *isosceles triangle*, has two equal sides, *a*, *b*, which may contain either a right angle, or an acute, or obtuse angle. If the of the physical characters, and a comparison of them in different minerals, will forward the acquisition of knowledge.

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External Form, &c.
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Hardness.
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Touch, Taste, and Odor.
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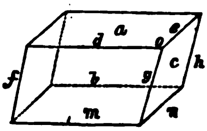

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The value or measure of angles is the number of degrees, minutes, &c. of which they consist.

In measuring angles, the circle is divided into 360 equal parts, called *degrees*; each degree into 60 equal parts, called as a prism of four, six, or eight sides, *terminated* by a pyramid of four or more sides.

§ 8. We have spoken of the *edges* and *solid angles* of crystals; these, however, are sometimes wanting; for, instead of the edge or the solid angle, we find a plane; the edge or solid angle is then said to be *replaced* or *truncated*. These are, however, merely terms of convenience; neither the edges nor angles ever were on the crystal, and therefore could not have been replaced, truncated, or taken off. But when it is said that the lateral or terminal edges are replaced, or when a solid angle or an apex is described as being truncated, it is meant only by a *single plane*, unless expressed to the contrary.[*]

When the edges of a crystal are replaced by two planes, separated only by an edge, they are said to be *bevelled*.

If any plane replacing an edge, and, being parallel to it, incline equally on the two adjacent planes; or if, replacing a solid angle, it incline equally on all the adjacent planes, it is called a *tangent plane*. Thus the planes replacing the solid angles and the edges of the octohedron, figs. 3 and 6, of red oxide of copper; the edges of the rhombic dodecahedron, figs. 2 and 3, of garnet; the lateral edges and terminal solid angles of the rhomboid, fig. 2, of carbonate of lime; and the edges of the hexagonal prism shown by the letter *d*, under the head of beryl; and of those of the tetrahedron shown by the letter *e*, under the head of grey copper ore — are a few examples of tangent planes that can be readily referred to.

§ 9. These truncations and bevelments are sometimes so slight as not to alter the *general* form of the crystal; but are often sufficiently deep to give it a perfectly different figure. Thus the octahedron *passes into* the cube, the cube into the octahedron, and the latter into the rhombic dodecahedron, as will presently be shown.

§ 10. These passages of one form into another, — and in many more respects than are above recited, — are constantly found to occur in certain mineral substances. This is not ideal. For not only may a series of crystals be observed which exhibit these transitions, but they may also be proved by evidence of the most convincing kind, arising out of an examination of these crystals by a method more decisive than that which depends on the accuracy of the eye The fact here alluded to is, that the crystals of many substances may, *by the application of force, be mechanically divided* or *cleaved*, in the *direction of the laminæ* (along their *natural joints*), so as to reduce the one form into the other; but the consideration of this fact belongs properly to that division of the subject which may be denominated structure.

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[*] We must, however, make certain exceptions to some of the preceding remarks in regard to prismatic crystals. Every crystal which has lateral and terminal planes is not considered as being prismatic; as, for instance, the *cube*, which is a solid of perfect proportion, all its sides being equal; so with the *rhombic dodecahedron*, which also appears, in some points of view, as having lateral faces; but as these solids are perfectly symmetrical, their apparently lateral and terminal faces are never so distinguished, and, when their edges are replaced, the fact is merely stated without distinction; indeed, it commonly happens in these perfectly geometrical solids, and in others, as the regular octahedron and the tetrahedron, that *when one edge is replaced, the others are so also.* [P.]

Structure.

§ 11. Structure, when it exists in a mineral substance, arises from the particular arrangement of the minute portions or molecules of which it is composed.

§ 12. In some minerals this arrangement exists both in the regular crystals in which these occur, and in those masses which have no particular external form.

§ 13. Of the forms of those minute and imperceptible molecules which are aggregated by the law of attraction into masses, nothing is known with certainty. Conjecture has in some instances been allowed to supply the deficiency. The consequences of this arrangement, however, are very perceptible, and may be satisfactorily proved, in some instances, by the rudest attempt; a slight blow, or letting fall a specimen of certain minerals on the floor or the pavement, will suffice to produce instantaneous conviction that this arrangement does exist; for by such means fragments of perfectly regular form may be obtained, and from the faces of these fragments may again be procured thin slices, of which the larger planes are perfectly parallel, and these slices may again be subdivided into regular forms, until the fragments are no longer perceptible without the aid of the microscope.

§ 14. Structure, then, it may be repeated, arises from the particular arrangement of the minute portions or molecules of which the mineral is composed.

If a mineral can be *mechanically divided* or *cleaved* in directions which produce only one particular form, that form is denominated its *primary* or *primitive crystal.* For instance, calcareous spar can only be cleaved into the form of an obtuse rhomboid of particular measurements, which therefore is termed its primary crystal; a rhomboid has six planes, which are parallel two and two. Calcareous spar therefore has three cleavages; it possesses *natural joints in three directions:* so has common salt, of which the primary form is the cube; and also galena.

But some minerals are not so circumstanced. Fluor spar, which may be cited as yielding with ease to mechanical division, is an instance. It cleaves in four directions, and affords three different forms, a regular octahedron, a regular tetrahedron, and an acute rhomboid; of these, the first has arbitrarily been selected as the primary crystal, and convenience may be assigned as the reason for the preference.

Other substances are cleavable in a still greater number of directions; for instance, blende, from which may be extracted a rhombic dodecahedron, and from this an obtuse rhomboid, an octahedron, an acute rhomboid, and an irregular tetrahedron; in this mineral, also, the choice of a primary crystal has been arbitrary, the rhombic dodecahedron having been selected.

Further instances might be cited, but these will suffice; they are particularly quoted because of the remarkable ease with which the learner may satisfy himself of the facts.

The faces produced by this mechanical separation of crystals, are usually called *faces of cleavage*, and they are, of course, parallel with the *faces of crystallization* of the primary form, or of those planes, by which the primary figure, when obtained, is bounded.

§ 15. Many minerals yield to cleavage with ease only in one direction, of which topaz is an instance. The structure of such is described as being *perfectly crystalline or lamellar in one direction.* Sapphire yields to cleavage in one direction with much ease; in the others with extreme difficulty.

§ 16. The arbitrary selections just noticed will suffice to induce the suspicion, that in this department Mineralogy has not yet attained perfection, and also to lead the pupil to investigate, as he advances in the science, rather than take for granted what is asserted without proving the facts.

§ 17. Other circumstances also exist, sufficient to make us extremely cautious on this point.

Some minerals, to which primary forms have been assigned, do not yield, or have not yet been found to yield, to regular cleavage in more than one direction, or even not in any direction. In these determinations one of two modes has been resorted to. In the first, thin fragments of the substance have been held up between the eye and the light; and by this means the Abbé Haüy was enabled in several instances to deduce the probable form of the primary, from the directions of the crevices, or *appearances of natural joints*, which are observable in the fragment; and, in many, these have afterwards proved to be correct. By the other mode, the primary form is determined by *analogy*, that is, by a comparison of the forms of the crystals of a mineral with those of other known substances; but this may in some cases prove a source of error.

Sometimes, also, the natural joints may be shown by simply heating the mineral, which causes them to separate; at others, the appearance of striæ may serve as a guide, as will be shown further on.

§ 18. Cleavage can be accomplished in various ways, dependent on the nature of the substance. In some, as in blende, it is best effected by a sharp knife, when the mineral is held between the fingers, because of its numerous natural joints, which a blow might disturb in the wrong direction. In sulphate of strontian it is done by the same means, for another reason; namely, because it is easily cracked in directions contrary to the natural joints, even by a slight blow. Fluor and calcareous spar are best cleaved by putting them on a table, and placing the edge of a knife or razor along their natural joints; a slight blow then separates them. The oxide of tin yields only to the pressure of the cutting pincers, when held in proper directions.*

§ 19. By one or other of the preceding methods, however, most minerals have had assigned to them some one solid, as the *primary form* of the several varieties of crystals in which they are found.

Primary Forms, and some of their Geometrical Relations considered.

§ 20. The system of Primary, or Fundamental Forms, according to which minerals are described in this treatise, is that adopted by Brooke in his "Introduction," and consists of fifteen in number. Their names are as follow: 1. *Cube;* 2. *Regular Tetrahedron;* 3. *Regular Octahedron;* 4. *Rhombic Dodecahedron;* 5. *Octahedron with a square base;* 6. *Octahedron with a rectangular base;* 7. *Octahedron with a rhombic base;* 8. *Right Square Prism;* 9. *Right Rectangular Prism;* 10. *Right Rhombic Prism;* 11. *Right Oblique-angled Prism;* 12. *Oblique Rhombic Prism;* 13. *Doubly Oblique Prism;* 14. *Rhomboid;* 15. *Regular Hexagonal Prism.*

By some authors these primary forms are not recognized as such, but they are all included under new systems of Crystallization, founded on what are called the "Axes of Symmetry" of Crystals, or "Axes of Crystallization" — a method which was first adopted by the German mineralogists, and originated with Weiss. Though they are actually observed forms, either natural, or obtained by cleavage, as will be shown under the species, it is obvious that in describing them, they may be reduced to fewer divisions, or classed according to certain geometrical affinities. Thus they could all be comprehended under the cube, the regular tetrahedron, the rhombic dodecahedron, the octahedron, the six-sided prism, and the parallelopiped; the term parallelopiped including all those solids whose bounding planes are parallel two and two; as, for instance, all the varieties of the rhomboid, both acute and obtuse; all prisms, both right and oblique, of which the terminal planes are rhombic; and all the square and rectangular prisms which do not possess the precise proportions of the cube.

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* For farther practical hints on this subject, *vide* Mr. Phillips's Communication to the London Geological Society, On the Primitive Crystals of Certain Substances, and on the Modes of cleaving them, inserted in vol. iv. of its transactions. [E. Ed.]

Weiss and Prof. Mohs include all under the Rhombohedral, Pyramidal, Prismatic, and Tessular Systems; and G. Rose, in his Treatise, published at Berlin in 1838, comprises them under "Six Systems of Axes of Crystallization." These have been adopted in England by Prof. Miller,* by whom they are thus stated; viz: the Octahedral, the Pyramidal, the Rhombohedral, the Prismatic, the Oblique Prismatic, the Doubly Oblique Prismatic. Mr. Brooke, also, in the late article attributed to him, in the Encyclopedia Metropolitana, has modified his system, and assumes only the Rhomboid, the Square Prism, the Right Rhombic Prism, Oblique Rhombic Prism, Doubly Oblique Prism, and the Cube; the last answering to the Tessular, the next three to the Prismatic, and the other two to the two first in the above-named system of Mohs. But, in the present edition of this work, the American Editor prefers to adhere to Brooke's original number of Primary Forms, as they have been generally adopted by American authors, and are, of course, familiar to our students. Besides, all the species in this work have been described in reference to them by Mr. Phillips, who, from a large number of observations and measurements, seems to have been satisfied that they afforded a true and natural explanation of the character and relations of form among crystallized minerals. Should the new systems generally prevail, the student will be better prepared for the investigation of them, by his knowledge of the less mathematical and abstruse method pursued in this.†

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* Treatise on Crystallography, by W. H. Miller, F. R. S., Professor of Mineralogy in the University of Cambridge. London, 1839.

† Mr. Griffith of Glasgow, the translator of H. Rose's Analytical Chemistry, endeavors to show that "the doctrine of primary forms is useless and mischievous, being equally unadapted for popular and for scientific nomenclature." His work (a System of Crystallography, with its application to Mineralogy; Glasgow, 1839) shows considerable inge-

Examples of these primary forms will be exhibited, with their various modifications, by secondary planes, when we come to describe the mineral species; but that the student may the more readily comprehend them, we shall offer a few explanations in the present connection, and introduce figures, (see p. xxxvi) having their angles, edges, and planes designated by appropriate letters, without which it would be impossible to convey to his mind any very accurate idea of the variety of crystalline forms. The vowels, A, E, I, O, are used to designate the *solid angles;* some of the consonants, B, C, D, F, G, H, to designate the *primary edges;* and P, M, T, (primitive) to designate the *primary planes* of crystals. The same letter is repeated where the angles, edges, and planes, are similar; and different letters are used when those angles, edges, or planes, are dissimilar, as explained on page xxvi. Thus, the letter A is repeated on the angles of the cube, these being all similar; while A and E are placed on the *alternate* angles of the right rhombic prism, to show that there the opposite angles only are similar. So the letter P is repeated in all the planes of the cube, for the same reason that they are all similar. In the right rhombic prism, (fig. 10) the letter P stands only on the terminal plane, the lateral planes having the letter M placed upon them. This implies that the lateral planes are not similar to the terminal plane; but the letter M being repeated on *both* the lateral planes, denotes that *these are similar to each other.*

In the *Right Oblique-angled Prism,* the lateral planes are distinguished from each other by the letters M and T, implying *that they are dissimilar to each other,* as both are to the terminal plane, which is designated by P.

The ′ and ″ added to some of the letters, are intended merely to distinguish two or more *similar planes* from each other.

It is not deemed necessary to give any figures of the *secondary* forms of crystals, as these modifications will be fully and familiarly shown in figures annexed to the descriptions of species in the body of the work, where they will also be frequently accompanied by the parent figure, from which they are all derived, or to which they may all be referred.

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nuity, and no small share of knowledge of his subject; but it is mainly based on the system of Rose, though, in its applications, it is somewhat modified. His notations and symbols, and all the machinery by which he describes the various combinations of forms, have not an attractive appearance, and, when understood, possess no advantages that will lead to the abandonment of the simpler methods adopted by Brooke and others, which are based on the idea of fundamental forms, and have now acquired the sanction of popular use. It may be observed that the models which are intended to illustrate his work, formed of cream-colored porcelain, and representing the most simple and complicated *natural crystals*, are as well adapted to one system as another, and they will be found to be of great practical utility to the student. They are from one to four inches in diameter, and sufficiently smooth to admit of very good *approximate measurements* with the goniometer. [AM. ED.]

Examples of Primary Forms.

The *Cube* may be seen in Native Gold and Silver, Iron Pyrites, Fluor Spar, Analcime, and Galena; the ***Tetrahedron*** in Grey Copper Ore; the ***Rhombic Dodecahedron*** in Garnet and Blende; the ***Regular Octahedron*** in Pleisto-magnetic Iron, Red Oxide of Copper, and Spinel; ***Octahedron with a square base***, in Zircon, Tungstate of Lime, Molybdate of Lead, and Anataste; ***Octahedron with a rectangular base***, in Arseniate of Copper; ***Octahedron with a rhombic base***, in Sulphur; ***Right Square Prism***, in Apophyllite, Scapolite, and Idocrase; ***Right Rectangular Prism***, in Harmotome, Phillipsite, and Anhydrite; ***Right Rhombic Prism***, in Mesotype, Topaz, and Sulphate of Barytes; ***Right Oblique-angled Prism***, in Sulphate of Lime and Heulandite; ***Oblique Rhombic Prism***, in Laumonite and Mica; ***Doubly-oblique Prism***, in Felspar, Sappare, and Axinite; ***Rhomboid***, in Quartz, Carbonate of Lime, Tourmaline, and Chabasie; ***Regular Hexagonal Prism***, in Beryl and Phosphate of Lime. By referring to the above-named substances, the student will find the various modifications of form, which have resulted from the replacement of some of the edges or solid angles belonging to the figures soon to be introduced, with the recorded angular measurements of many of the most commonly occurring natural crystals. The small letters resting upon the planes which have replaced the primary edges and angles, as shown in these figures of natural crystals, are intended to distinguish the classes of modifications by which they have been derived from the primary forms. They are characters of much importance in describing crystals, and as their application is uniform, they may be easily remembered after a little study. For the entire series of transformations which they are intended to express, but which are too numerous to be here introduced, the student is desired to consult the "Tables of Modifications" in Brooke's Crystallography. A few references to the figures in the body of the work, which should be compared with those which are lettered in the following section, are all that will be required in these introductory remarks. Under the species Native Gold, the solid angles of the Cube are replaced by tangent planes, class *a*, passing into the Octahedron. Under Analcime, the same figure has its solid angles replaced by three planes, class *b*, producing a figure with 24 trapezoidal faces, the ordinary form of this mineral; the replacement of its solid angles by three planes, class *c*, resting on the edges, produces a figure having 24 isosceles triangular planes; this may be seen in Iron Pyrites.

Class *d*, the replacement of the solid angles by six planes, forming a figure containing 48 triangular faces, which may be seen under Fluor Spar, fig. 12.

When the edges of the cube are replaced by tangent planes, class *e*, the new figure produced will be a Rhombic Dodecahedron. When its edges are replaced by two planes, class *f*, a series of four-sided pyramids is formed on the faces of the Cube.

Class *g*, alternate solid angles replaced by tangent planes, producing the Regular Tetrahedron.

Class *k*, edges replaced by single planes inclining at unequal angles on the adjacent primary planes. They give rise to the Pentagonal Dodecahedron, shown in figs. 5 and 6, under the species White Cobalt. The incipient planes of this class may be seen on the large figure, under the same species.

In the Regular Tetrahedron, class *a* shows the replacement of the solid angles by tangent planes; class *b*, the same angles replaced by three planes resting on the primary planes; class *c*, by three planes resting on the primary edges; and class *d*, by six planes. Class *e*, edges of the Tetrahedron, replaced by tangent planes; class *f*, edges replaced by two planes. These several modifications may be seen in the large figure, under the species Grey Copper.

In the Regular Octahedron, class *a*, angles replaced by tangent planes; class *b*, solid angles replaced by four planes resting on the primary planes; class *c*, by four planes inclining on the primary edges, the first resulting in the Cube, the second in a figure with 24 trapezoidal planes, the last in one with 24 isosceles triangular planes; class *d*, solid angles replaced by 8 planes, producing the same result as class *d* of the Cube, or a figure having 48 triangular planes (fig. 12 of Fluor Spar). Class *e*, edges of the Octahedron replaced by tangent planes, tending to the Rhombic Dodecahedron, shown in fig. 3, and large figure, under Magnetic Iron; class *f*, edges replaced by two planes, fig. 9, under Red Oxide of Copper. The large figure, under the same species, shows the replacements answering to *a*, *b*, *c*, *d*, *e*, and *f*.

Rhombic Dodecahedron, class *a*, acute solid angles replaced by tangent planes, by which the figure is passing into the Cube; class *b*, by four planes resting on the primary planes; class *c*, by four planes resting on the edges, producing the trapezohedron, contained under 24 equal trapeziums, as shown in fig. 4, under Garnet; class *d*, same angles replaced by 8 planes; class *e*, obtuse solid angles replaced by tangent planes, passing into the Regular Octahedron, as shown in figs. 2, 3, and 4, of Blende; and also by the large figure, under the same species. Examples of the various other modifications, according to the different classes, may be seen under some of the substances named in the beginning of this section.

Characters of Primary Forms.

The *Cube*, fig. 1, is contained under six square faces, and has a similar axis in four directions passing through its centre, and through each pair of opposite solid angles, as from A to its opposite in the figure. Only one is shown in the figure.

Fig. 1.

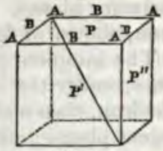
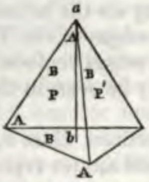
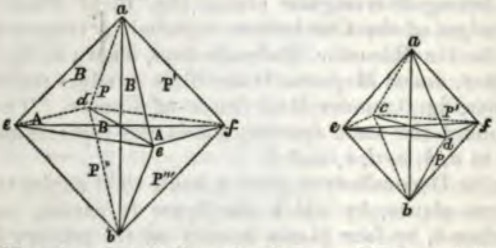


Fig. 2.



The *Regular Tetrahedron*, fig. 2, is contained under four equilateral, triangular faces, and has a similar axis in four directions, in consequence of its symmetrical form, as the one shown from *a* to *b* in the figure; plane P on P′, 70°, 31′, 43″.

Fig. 3.

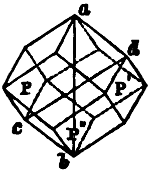


The *Regular Octahedron*, fig. 3, is a solid bounded by eight equilateral triangles, or it consists of two equal four-sided pyramids applied base to base, the base being a square. The edges, *c e*, *e f*, *f d*, *d e*, at the junction of the two pyramids, are called the edges of the base; and the four solid angles *c e f*, and *d*, are called the angles of the base; those at *a* and *b*, the angles of the summits. The plane angles of the summit measure 60°. The inclination of the faces, as P on P′, or P″, 109°, 28′, 16″.

The line connecting the angles of the summits, *a b*, is called the axes of the crystal; and the regular octahedron, having all its angles similar, may be said to have a similar axis in three directions.

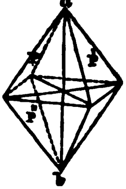
The ***Rhombic Dodecahedron***, fig. 4, is contained under twelve equal rhombic faces; it has ***two dissimilar sets of axes*** passing through its centre; one set, as *a*, *b*, passes through the pairs of opposite solid angles which consist each of ***four acute plane angles***, and may be called the greater axes; another set, as *e d*, passes through the solid angles which consist of ***three obtuse plane angles*** each, and may be called the lesser axes of the crystal. The angles contained within the four acute plane angles are called the acute solid angles, and those within the obtuse plane angles, the obtuse solid angles. It is said to be in position when, as in the figure, one of the greater axes is in a vertical situation. The mutual inclination of the adjacent faces, as P on P″ = 120°; the inclination of faces united by their acute angles, as P on P′, = 90°.

Fig. 4.



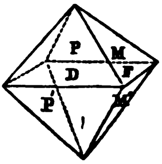
The ***Octahedron with square base***, fig. 5, is contained under eight equal, isosceles triangular faces, and has the same number of axes as the regular octahedron. Crystals of this class will differ from each other in the inclination of P on P″, and of P on P′. And the angles of the summits, *a* and *b*, may be less or greater than 60°. When less, the octahedron is called acute; when greater, obtuse.

Fig. 5.



The ***Octahedron with rectangular base***, fig. 6, is contained under eight triangular planes, which are usually isosceles triangles, though four of them may be equilateral. Its axes will also be distinguished as the same in number with the regular octahedron. Like the latter, crystals of this form will differ from each in the inclination of P on P′, or M on M′.

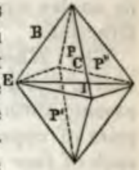
Fig. 6.



In this figure the broad planes P P′ meet at the edge of the base at a more obtuse angle than the narrow ones M M′. The edge D may therefore be regarded as the ***obtuse edge*** of the base, and the edge F, the acute; or we may call one the *greater* and the other the *lesser* edge of the base.

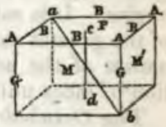
The *Octahedron with a rhombic base,* fig. 7, is contained under eight equal scalene triangles. Crystals of this class will differ from each other in the inclination of P on P′, and of P on P″. Octahedrons are said to be in *position* when they are so held or placed that their bases are *horizontal.* This last figure is drawn with the *greater diagonal* of the base horizontal; that is, in the direction of the two farthest opposite angles of the base (a diagonal signifying a line connecting two opposite angles of any parallelogram). The faces meet at the edge B, at a more acute angle than at the edge C. One is therefore called the *acute*, and the other the *obtuse* edge of the pyramid. The solid angle at E will be termed the *acute lateral solid angle*, and that at I, the *obtuse lateral solid angle.*

Fig. 7.



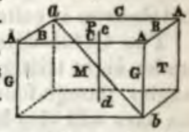
The *Right Square Prism* is a quadrilateral solid whose edges B and G (fig. 8) are unequal, or whose bases are equal squares, and sides are equal rectangles. It has an axis in four directions similar to the cube, and a line connecting the centres of the bases, which is called the *prismatic axis*, as *c*, *d*. The lateral edges G G, are always longer or shorter than the terminal ones B B: otherwise the form would be a cube. Crystals of this class will of course differ from each other in the comparative length of the edges G and B.

Fig. 8.



The *Right Rectangular Prism* (fig. 9) is a quadrilateral solid whose bases are equal rectangles.* It has the same number of axes with the last figure described. The lateral edges G G, are similar, but of a different length from the terminal edges C B, which are not equal. Individuals of this class will differ from each other in the comparative length of the edges C, G, and B.

Fig. 9.



The *Right*† *Rhombic Prism* (fig. 10) is a quadrilateral solid, whose bases are equal rhombs, and whose lateral planes are either equal squares, or equal rectangles. Besides the prismatic axis *e*, *f*, it has *two greater* and *two lesser* axes; the first pass through the solid angles which terminate the *acute edges* of the prism, as E *e*, and the latter through those which terminate the *obtuse edges* of the prism, as A *a*. The solid angles at A are the *obtuse*, and those at E the *acute, solid angles*. The edge G and its opposite are the *acute*, and the edge H and its opposite, the *obtuse, lateral edges*. Examples of this class of crystals will differ from each other in the inclination of M on M′, or in the ratio of the edge H to the edge B. It is said to be in position when on its rhombic base, with an obtuse edge towards the observer.

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* The difference between the right square and the right rectangular prism will be readily understood by calling to mind the definition given of a *square* and a *rectangle*, at p. xxvii, or, to convey a more direct meaning, he may call one a *right prism with a square base*, and the other a *right prism with a rectangular base*; the base of one having its edges all of equal length, while the other has its opposite edges only equal, or its adjacent edges unequal.

† The student will observe that prisms are called *right* or *oblique* when, supposing them to be held with their *lateral* planes perpendicular, their terminal planes are either at *right angles* with them, or are placed *obliquely*, at a greater or less angle than 90 degrees. In the quadrilateral or quadrangular prisms, it is evident that two of the faces are chosen as bases.

Fig. 10.

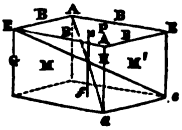
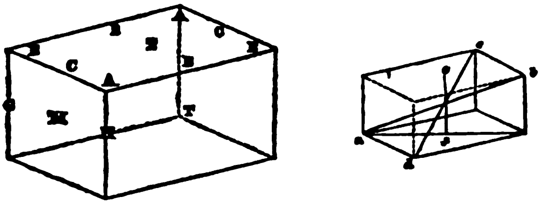


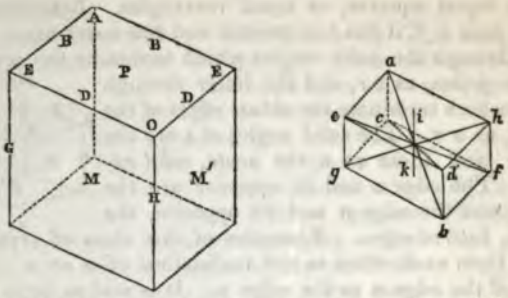
Fig. 11.



The *Right Oblique-angled Prism* (fig. 11) is a quadrilateral solid, whose bases are equal oblique-angled parallelograms. Besides the prismatic axis, (small fig.) it has the same axes as the last primary form described, and like it, its angles and edges may be similarly designated: A *obtuse*, E *acute*, solid angles. The lateral edges at H are the *obtuse*, those at G the *acute*, lateral edges. The edges B are the *greater*, and C the *lesser*, *terminal edges*. Examples of this class will differ in the inclination of M on T, and in the relative lengths of the edges C, B, H.

The *Oblique Rhombic Prism* (fig. 12) is a quadrangular prism, whose bases are equal rhombs, and whose lateral faces are equal oblique-angled parallelograms. Besides the several axes described in the last figure, the oblique rhombic prism has two *transverse* axes which pass through the lateral solid angles *e*, *f*, *g*, *h*, of the small figure. The figure is supposed to be oblique in the direction O A, of the large figure; so that the terminal plane forms an obtuse angle with the edge H. The planes M M′ may meet at an acute or an obtuse angle. If at the former, the prism is said to be *oblique from an acute*

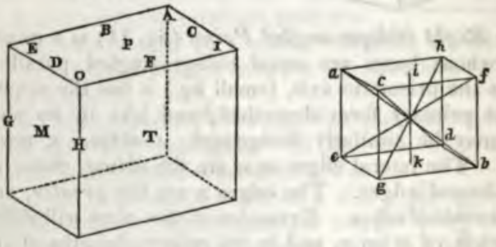
Fig. 12.



edge; if at the latter, *oblique from an obtuse edge.* The *solid angle* at A may, in either case, be called the *acute solid angle;* that at O, the *obtuse solid angle;* and those at E, the *lateral solid angles.* The edges B are called the *acute terminal* edges, and those at D the *obtuse terminal* edges. The edge H and its opposite are the *oblique edges of the prism,* and G and its opposite, the *lateral edges of the prism.*

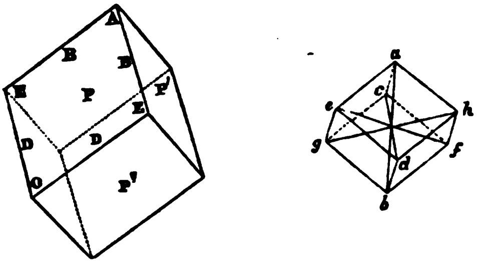
Individuals of this class will differ from each other in the inclination of M on M′, and in the ratio of the edge H to the edge D.

Fig. 13.



The *Doubly Oblique Prism* (fig. 13) is a quadrangular solid whose bases are equal oblique-angled parallelograms. Besides the prismatic axis, it has four unequal axes passing through the opposite pairs of solid angles, which are shown in the small figure. It differs from the oblique rhombic prism in the angles A, E, I, and O, which are dissimilar, and also in its acute terminal edges B, C, and its obtuse terminal edges D and F. It is supposed to stand oblique in the direction O, A, so that the terminal plane forms an obtuse angle with the edge H. The prismatic axis inclines from a perpendicular. The same terms used in designating the edges and angles of the oblique rhombic prism, may be employed in describing corresponding ones belonging to this class. The individuals will differ from each other in the inclination of P on M, P on T, and M on T, and in the ratios of the edges D, H, and F.

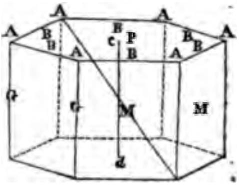
Fig. 14.



The *Rhomboid* (fig. 14) is a solid contained under six equal rhombic planes. The line *a b* (small figure) which passes through the summits, is called the *perpendicular axis*, and the lines *c d*, *e f*, *g h*, which pass through the opposite pairs of lateral solid angles, are termed the *transverse axes;* those from *a* to *b*, and *c* to *d*, are sometimes called the *greater* and *lesser* axes of the rhomboid. The crystal is said to be in *position* when the perpendicular axis is vertical. The solid angle A (large figure) and its opposite, forming the other extremity of the greater axis, are called the solid angles of the summit, or the *terminal solid angles;* the edges B the *terminal edges*, or edges of the summit; the solid angles at E, the *lateral solid angles*; and the edges D, the *lateral edges*. Individuals belonging to this class are usually distinguished from each other by the inclination of P on P′. When P on P′ measures more than 90°, the rhomboid is called *obtuse;* when less, it is called *acute*.

The *Regular Hexagonal Prism* (fig. 15) is a right prism whose bases are regular hexagons. Any two of the contiguous lateral planes, as M on M′, measure 120°. The line represented from A to the opposite solid angle, may be regarded as one axis, and it may have as many axes as it has opposite solid angles; but the line *c d*, passing through the centre, or the prismatic axis, is the only one now referred to in describing the modifications of this form. Individuals of

Fig. 15.



this class will differ from each other in the ratio of the edge G to the edge B.

Mechanical Cleavage and the Secondary Forms of Crystals considered.

§ 21. Whoever undertakes, for the first time, the examination of the crystalline forms of a mineral, will find, if they be numerous, that many of them seem to possess *no mutual relation.*

§ 22. He will, however, eventually discover that a substance, from whatever country it may be brought, always assumes crystals, which, if they yield readily to mechanical division, will always afford by it the same *nucleus* or primary form.

§ 23. Hence we have a right to conclude that the form of the molecules constituting these crystals must invariably resemble each other in the same substance, and that their arrangement must be invariable in regard to each other.

§ 24. How comes it, then, will be the inquiry, that so great a diversity of external forms should be produced by an invariable internal arrangement? A satisfactory answer to this question cannot perhaps be given. We only know the fact, and are compelled in general terms to suppose it to be the consequence of affinity, or attraction, or polarity; of laws to which matter is subject. We must not, however, fail to notice the curious and important fact, that the crystals of a mineral, from what part of the world soever it may be brought, and however unlike each other at first sight in external form, are always found to possess such a mutual relation as will enable the observer to trace them to the same primary form.*

§ 25. A few of the many minerals which may be cleaved with regularity have already been noticed (§ 14), and we have pointed out the manner in which the crystals of certain subaces may be reduced to their primary forms (§ 18). Let now attend to the manner in which the primary forms of tain minerals may be supposed to have increased, so as to ume external forms which appear to have little or *no affinity* *h the primary.*

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* This fact, that the angles of similar planes of a crystal of the same mineral, whatever may be its dimensions, precisely agree in their measurements, seems to have been entertained at a very early date. Nicolas Steno, a Dane, published a dissertation in 1669, in which he says, "that though the sides of the hexagonal crystal may vary, *the angles are not changed.*" And Dominic Gulielmini, in 1707, expresses the same idea, though in more remarkable language. He says: "Nature does not employ all figures, but only certain ones of those which are possible; and of these the determination is not to be fetched from the brain, or proved *á priori*, but obtained by experiments and observations. Since there is here a principle of crystallization, the inclination of the plane and of the angles is always constant." Henckel of Saxony, in 1827, described several classes of minerals in reference to their forms; and the enthusiasm he displays on the subject is well worth recording. "Neither tongue nor stone can express the satisfaction which I received on setting eyes upon this spar covered with galena, (probably the beautiful polished crystals which we often see accompanying the spar from the mines of Saxony) and thus it constantly happens that one must have more pleasure in what seems worthless rubbish, than in the purest and most precious ores, if we know aught of minerals." Linnæus first attempted to *arrange* minerals according to their crystalline forms. The first persons who seem to have had any notion of the *truncation* of the angles and edges of crystals, and the consequent passage of one form into another, are Werner, in 1774, and Démeste, in 1779. But the true relations of the changes of form were not understood until Romé de Lisle and Haüy brought their mathematical minds to the subject, and

The forms thus produced are called *secondary forms*, and wever numerous or complicated they may appear, they are imately reducible to the same central nucleus of the species, en it is susceptible of cleavage. It must not, however, be posed that the primary nucleus is always concealed by the er-position of particles which give rise to these secondary ms; on the contrary, there are many mineral species in ich the primary form, either perfect, or but slightly modified its edges or angles, is the one which prevailingly occurs in ure. This is shown in the case of the regular hexahedron beryl, and the octahedron in diamond, spinel and pleistogaetic iron. The number of secondary forms which ually occur is very large, but the possible number which y occur, of variable dimensions, may be said to be infinite. lcareous spar alone has presented to our observation uprds of eight hundred different varieties of form, derived from obtuse rhomboid.

§ 26. In examining a cubical crystal of fluor, we find that *its solid angles* may readily be taken off by means of a ife; and that by thus displacing each angle, we produce ht triangular planes, which are smooth and brilliant; we reover find that it cannot be cleaved, so as to produce a lliant plane in any other direction.

Fig. 1.

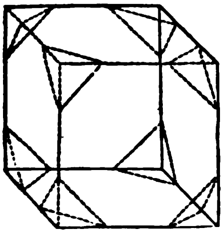
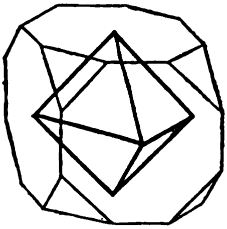


Fig. 2.



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the foundations of a new and beautiful science. The former, in 1783, speaks of the riability of the angles of crystals of each kind, under all the changes of relative dimens which the faces may undergo; and shows that this law applies only to the *primitive* s, from each of which many secondary forms are derived by various changes. He strates this principle in its application to a large number of crystals, of which he gives wings in his work. But Haüy may be said to have shown its truth by its application he whole mineral kingdom; and to him we are indebted for our knowledge of the ertance of *cleavage*, and the consequent expression of the laws of deviation of the ndary from the primary forms, by means of the *decrements* of the successive layers of

§ 27. Then let the *lines* of fig. 1 represent a cube, and the *dotted lines*, the triangular planes produced by cleavage.

§ 28. The cube having its solid angles displaced, is also represented in fig 2. If, however, we pursue the cleavage by which we produced the triangular planes; that is, if layers or laminæ parallel with those planes are removed, we reduce the volume of the crystal by degrees, and finally change its form; for we ultimately find that the eight triangular planes of the cube become the eight triangular planes of the octahedron within it. Let us not fail to observe that the termination of each solid angle of the octahedron forms, as it were, a point in the centre of each plane of the cube.

§ 29. If we still go on, and remove from each plane of the octahedron other laminæ, we thereby reduce its size, but do not alter its form; hence the octahedron is considered to be the primary form of fluor.

§ 30. Every one of the laminæ taken off in this process may be again subdivided; it may be broken into octahedrons, tetrahedrons, and acute rhomboids (§ 14).

§ 31. Assuming, then, the octahedron to be the primary form of fluor (§ 14), and knowing that all its laminæ may be divided into regular forms, is it not reasonable to conclude that the whole cube, upon which we first began to operate, is composed of minute solids of a definitive form, *whatever that form may be;* and since the cleavage is attainable only in the directions specified (§ 26), is there not reason for concluding that they must be arranged with perfect regularity?

§ 32. Hence *the cube* (which is therefore one of the *secondary* forms of fluor) *appears to be the consequence of a regular arrangement, on the planes of the primary octahedron, of extremely minute solids, resembling each other in respect of form.* We may assume this without pretending to decide the precise form of those molecules or integrant particles.

§ 33. When, therefore, we describe a crystal of fluor, as being a cube of which the solid angles are (naturally) replaced by triangular planes, we do not describe it either truly or philosophically; but we thus describe it from motives of conveni-

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integrant molecules. Gahn, a German philosopher, was the first who observed the regular integrant rhomboidal structure of calcareous spar. Bergman took up the idea, and showed how, in various ways, crystals of this substance may be produced by the union of small rhomboids from one single figure. And it is not certain whether Haüy was aware that Bergman had thus, several years before him, shown that an hexagonal prism of calc-spar was made up by the juxtaposition of solid rhombs on the planes of a simple rhombic nucleus. As he makes no mention of Bergman's recognition of this fact, though he refers to his memoir on the subject, it is probable that it was original with them both. For many other important facts in the history of the science of crystals not generally known, the student is referred to vol. iii. of the eloquent and learned "History of the Inductive Sciences," by the Rev. William Whewell. [AM. ED.]

ence; we might more aptly term it a cubo-octahedron, because the triangular planes belong manifestly, from what has preceded, to the octahedron, and the larger planes to the cube (§ 28). But there are few crystals to which terms so convenient could be applied.

§ 34. Let us take one more example, in which the regular octahedron is the primary; this will also apply to fluor.

Fig. 1.

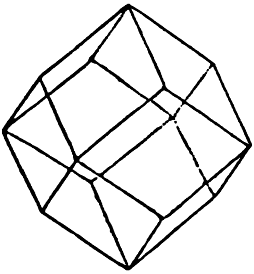
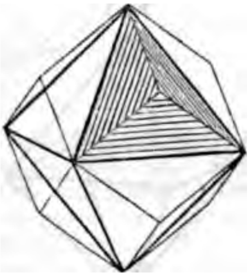


Fig. 2.



§ 35. Let fig. 1 represent a crystal of fluor in the form of the rhombic dodecahedron.

The same form is visible in fig. 2, and within it an octahedron; the lines of the latter being somewhat the darkest.

§ 36. Now, by the latter figure, we perceive that the rhombic dodecahedron is the consequence of an accession of crystalline laminæ composed of molecules placed in regular succession on every plane of the primary; the laminæ regularly diminishing in size until they arrive at a point, and producing on every plane of the octahedron a low three-sided pyramid.

§ 37. On one plane of the octahedron in fig. 2, the laminæ, progressively diminishing and terminating in a point, are shown by lines, and these lines or striæ are often visible in the rhombic dodecahedron, when the primary is an octahedron. Whenever striæ are seen on the planes of a crystal, they generally denote that it may be cleaved along them. These may be observed in dodecahedrons of fluor and red oxide of copper, of which the primary is the regular octahedron; and if the substance does not yield to cleavage, they sometimes serve as a clue to the determination of the primary form.

But it may be asked, how does it happen, that if these laminæ progressively diminish, forming, as represented in fig. 2, a sort of step from one to the next, that the planes have sometimes a perfectly brilliant polish, without any of the roughness which in such a case might be expected. The answer is simple.

The molecules composing the crystal may be termed almost infinitely small, since *no limit has been found to mechanical division.*

§ 38. Hitherto the octahedron has been assumed as the primary; let us now take the cube, and suppose the octahedron and rhombic dodecahedron to be its secondary crystals, as they are in several minerals. Afterwards the pentagonal dodecahedron will be considered as arising from the same primary form.

Fig. 1.

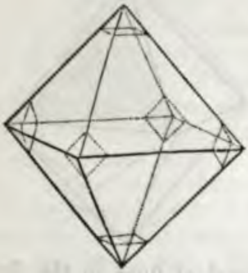
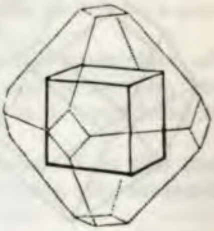


Fig. 2.



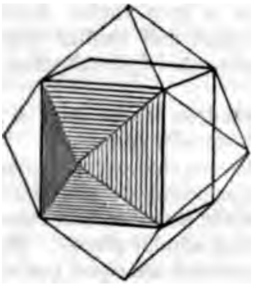
§ 39. Let the *lines* of fig. 1 be a regular octahedron, and let the square formed by *dotted* lines represent the planes which would be produced by replacing the solid angles.

§ 40. In fig. 2, the octahedron is represented as having its solid angles replaced, and a cube within it. On considering the relations of these two figures, it is manifest that, by pursuing the cleavage parallel with all the planes produced by displacing the solid angles of the octahedron, we ultimately convert that form into the cube. This might be performed in the instance of common salt, but octahedral crystals of salt are rare. If, however, we apply the knife, or the hammer, to each of the solid angles of an octahedron of galena, we find that they may readily be taken off, so as to obtain a brilliant cube.

§ 41. By pursuing the division still further, that is, by taking off laminæ in the same directions, we only reduce the volume of the cube, not alter its form.

§ 42. If then the cube, which, in this case, is the primary crystal, can *only be cleaved into cubes* (as is the case with common salt and galena), we conclude that the octahedron, which is only a secondary form, has arisen from an accession, on every plane of the primary cube, of crystalline laminæ *composed of minute cubes;* the points of the solid angles of the cube being, in the preceding figure, precisely in the centre of the planes of the octahedron.

§ 43. Let us now consider the rhombic dodecahedron as arising from the cube.



This figure represents the rhombic dodecahedron, having within it a cube. On considering the relation of these two solids, we conclude that the rhombic dodecahedron, which is the secondary crystal, arises from the primary cube by an accession of crystalline laminæ on each plane of the cube, so as to form thereon a low quadrangular pyramid; and progressively diminishing in size, so as to terminate in a point. This pyramid, if the primary can *only be cleaved into cubes*, is assumed to be composed of cubic molecules, regularly arranged.

§ 44. These laminæ, progressively diminishing, are represented on one plane of the primary nucleus, and the same observations apply to the crystals thus formed as were made upon the rhombic dodecahedron arising out of the octahedron (§ 34). The striæ, it has been observed, sometimes denote the primary. In this case it will be seen that their direction is parallel with *the lesser diagonals of the rhombic planes*; and the existence of these striæ in the aplome, usually ranked as a variety of garnet, induced the Abbé Haüy to suspect its primary to be a cube.

Fig. 1.

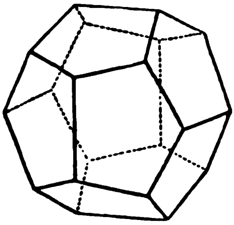
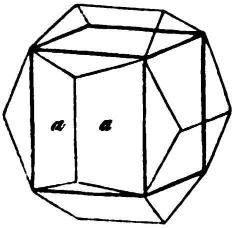


Fig. 2.



§ 45. We now proceed to consider the trapezoidal dodecahedron as a secondary crystal of the cube, in other words, as arising from a regular deposition of crystalline laminæ on the planes of that solid.

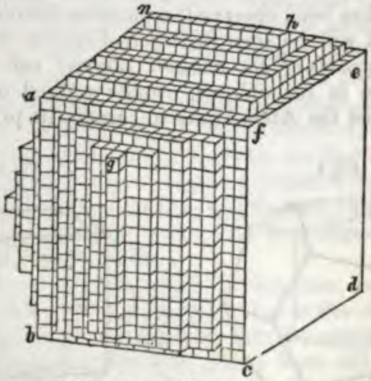
Fig. 1 represents a trapezoidal dodecahedron; a solid bounded by twelve equal and similar trapeziums; it is sometimes termed the pentagonal dodecahedron, all its planes being five-sided.

The same dodecahedron is also seen in fig. 2, having within it a nucleus in the form of a cube.

§ 46. We here observe that on each plane of the cube there is an equal and similar pyramid; and that each pyramid is not, as in the instance of the rhombic dodecahedron just described, composed of equal and similar planes. But, in this instance, the planes of each pyramid are equal and similar, two and two; *a* and *a* resemble each other; and the two small triangular planes, the one above, the other below the planes *a*, *a*, also resemble each other.

§ 47. Here, therefore, there must necessarily be an arrangement of the little cubic molecules of which the crystal is assumed to be composed, very different to that which, in the instance of the rhombic dodecahedron, produced a precise uniformity. Here, between *a a* we have a line, but the four planes on each surface of the cube terminated, in the rhombic dodecahedron, in a point — in a single cube.

§ 48. Let us observe whence this difference of form arises, on the assumption that the crystal is composed of cubic molecules.



Let *a*, *b*, *c*, *d*, *e*, *f*, be the cubic nucleus, or primary crystal, composed of minute cubic molecules.

Then *a*, *f*, *e*, *h*, *n*, will be one of the six pyramids on the planes of the cube.

§ 49. Now there is a remarkable difference in the arrangement of the cubic molecules on the two sides of this pyramid, which are obvious to us; the same difference will consequently exist between the other two. On the side *a*, *f*, *h*, *n*, which resembles the steps of a stair-case, we observe that these steps are *two ranges of molecules in breadth*, and only *one in height*. But the very reverse of this is the case of the side *f*, *e*, *h*; for in this, the molecules *are two ranges in height and only one in breadth*.

§ 50. The consequence of this difference in the arrangement of the molecules is, that the *quadrangular* sides of the pyramid incline much more upon the upper plane of the cube than those which are *triangular*. Not so in the instance of the pyramids on the planes of the cube forming the rhombic dodecahedron (p. xlvii); for in them, as in all the preceding figures, the super-position of molecules on the primary nucleus is *on every side* equal and similar, producing equal and similar planes, and precisely equal measurements in every direction. The structure in those crystals may therefore be termed *simple:* as the planes decrease *equally* to a point, they are said to arise from a *simple decrement*.

But the structure of the pentagonal dodecahedron may be termed *compound*, because its planes do not decrease *equally* on all sides; the *decrement is compound*. Of this species of structure there are several varieties.

§ 51. But it may be objected, that since the molecules of which crystals are constituted are too minute to be detected by the help of the most powerful glass, every thing which can be said in regard to the form of these molecules must necessarily be theoretical.

§ 52. This of course will be granted. We are not specially contending for any peculiar form in the integrant particles of matter; but only for this,—that since the crystals of a substance yield to mechanical division in particular directions, and cannot be made to yield to it with regularity in other directions, *these particles, whatsoever may be their form, must necessarily resemble each other, and be arranged with the utmost regularity; and also that this perfection of internal structure is the cause of regular external form.*

§ 53. The planes of the rhombic dodecahedron (p. xlvii) meet each other under an angle of 120°, and those of the pentagonal dodecahedron, (same page) under different angles.

In the determination of the value of these angles, calculation has been resorted to for the purpose of confirming the measurements obtained by the goniometer: and thus it has been decided that the *pyramid* formed on each plane of the cube, in the instance of the rhombic dodecahedron (§ 43) (being composed of planes which are equal and similar, and the measurement of any one upon the next being uniformly the same), that those pryamids must be composed of laminæ superimposed in regular order on every side; namely, of *one molecule in height, and one in breadth.* But as the planes of the pyramid superimposed on each face of the cube are dissimilar and unequal (or similar and equal only two and two) in the pentagonal dodecahedron (§ 45), so they afford different results under the goniometer, which have been confirmed by calculation; for by calculation it has been determined that the angles under which these planes meet, could *only be in consequence* of a superposition * of laminæ on each plane of the cube, of two molecules in height and one in breadth on the one side, and of one in height and two in breadth on the other (§ 49.) *And whether we assume these molecules to be cubes, or any other form, we must assume them to be equal to each other; and if so, whatever may be their form, the same structure would ensue.*

§ 54. By means of calculation the Abbé Haüy determined the angles under which the secondary planes meet, which result from an increase of laminæ on the cube and octahedron, and on other geometrical solids, considered as primary crystals: and thus, if we procure a portion of a crystal presenting only two planes of one of the varieties of those solids, we may decide which they are,—the use of the common goniometer will approximate the truth sufficiently to enable us to decide by a reference to his measurements, which may doubtless be relied on in every instance wherein the primary crystal is a perfectly geometrical solid, as the cube, the regular octahedron, the tetrahedron, the rhombic dodecahedron, and the six-sided prism: for, *the angles formed by the meeting of any two planes of these solids being accurately known, it follows that the angles of the secondary planes may be accurately calculated.*

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* It is a conclusion necessarily arising from the structure of crystals, that those which are secondary result from a superposition on the primary nucleus, of laminæ, which are composed of regularly arranged molecules.

But the usual mode of describing the manner in which the secondary forms arise out of the primary, supposes the contrary to be the fact. The secondary crystal is described as arising out of the *replacement of the edges or angles*, or both, of the primary crystal.

Thus, in the instance of Red Copper, it is said that the primary is an octahedron; that fig. 6 arises from the *replacement of its edges:* but fig. 6 is in reality the consequence of a very opposite cause — of an *increase of laminæ on the planes of the octahedron*, the laminæ diminishing progressively in width. Fig. 7 is described as the consequence of a deeper, fig. 8 of a complete, replacement of its edges, by which the octahedron is converted into the rhombic dodecohedron — when, in fact, these crystals arise from an increase of laminæ *on the planes*. progressively diminishing to a point.

It may be inquired, why, in these descriptions, a mode is adopted which is diametrically opposed to fact. The reply is, that it is convenient. If the fact were adhered to, the descriptions would be long, and scarcely intelligible; and, in effect, it matters not which method is adopted, for the same consequence is arrived at in either case.

The beginner may convince himself of the truth of this assertion, by moulding or cutting a piece of wax or of soap, into the form of the octahedron; then let each edge be cut away (*replaced*) by a knife, and the ultimate consequence will be the rhombic dodecahedron. Let then those solid angles of the dodecahedron which are formed by the meeting of three planes, be in like manner replaced by a knife, and the consequence will be, that in lieu of each there will be a triangular plane; if these triangular planes (eight in number) be increased by deeper replacements parallel with each, the rhombic dodecahedron will ultimately be converted into the octahedron. Thus the assertion is proved, that *whether we describe this secondary crystal as arising from the replacement of the edges of the primary, or from increase on its planes, the effect is the same.*

This practice is recommended to the beginner, not simply as regards the above fact, but also as a pleasing method of convincing himself of the transitions of crystalline forms. [P.]

§ 55. There are other primary forms, as has been observed, which are not regular geometrical solids; for instance, all those varieties of the octahedron of which the sides of the planes are not equal and similar; the primary octahedron of the oxide of tin is flatter than the regular octahedron, and that of sulphur is more acute. The varieties of the parallelopiped also are not regular geometrical solids, as the acute and obtuse rhomboids, and the varieties of prisms whose bounding planes are equal and similar two and two.

Hemitrope Crystals.

Crystals of certain minerals present us with singular appearances or changes, which we may suppose them to have undergone, by which one half is described as having revolved or turned round on the other, in a certain line or imaginary axis, through the centre of, and perpendicular to, the plane of section, and in a quantity equal to one half of a circle, or 180°. This imaginary axis has been termed the *axis of revolution*, and the section the *plane of revolution*. But it is obvious that such a revolution has never actually occurred, and the origin of these anomalies must be ascribed to certain laws which operated upon the molecules from the time they began to arrange themselves in the commencement of the crystal, until its final completion: a power analogous to that by which other secondary forms are produced. To these forms Romé de Lisle applied the term *macle;* but as this term was soon assigned to a particular mineral species, they were afterwards denominated, by Haüy, *hemitrope crystals*, an appropriate expression for the demi-revolution which they are supposed to have undergone. They are also sometimes called *twin crystals*, implying that they are composed of pairs of single crystals, which have been united by particular planes.

One or two examples, taken from Haüy (*Traité de Minéralogie,* tom. ii. edit. 2de. p. 169), will be sufficient to convey a perfect idea of these phenomena. Suppose an octahedron, (fig. 1) to have a line passing through its centre, parallel to the two triangles *b c g*, *p f d*. Each half of the octahedron (for example, the superior half) will have for its base, in one part, a regular hexagon *k n x c o h*, which may be called the plane of junction, and in the other an equilateral triangle *b c g*, and for lateral faces three trapezia, *c b c x*, *g c n k*, *g b o h*, and three equilateral triangles, *n c x*, *c b o*, *k g h*, which alternate with the trapezia. In fig. 2 the two halves of the octahedron are separated one from the other.

Fig. 1.

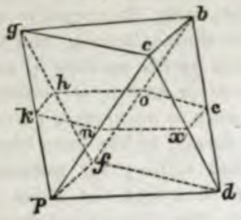
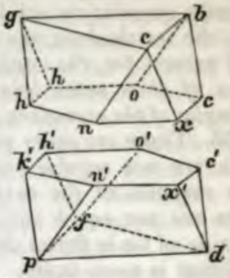
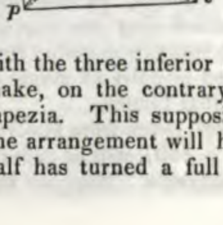


Fig. 2.



Let us now imagine the superior half turned on the inferior for a sixth of its circumference, and we shall have the arrangement represented by fig. 3, in which *h k n x c o* indicate the position of the hexagon which belongs to the superior half, fig. 1, and which has turned so that the point *k*, which answered to the point *k'*, answers now to the point *n'*, and so with the others. By a necessary consequence the three superior triangles make *re-entering angles* with the three inferior ones, and the three superior trapezia make, on the contrary, *salient* angles with the three inferior trapezia. This supposition is the simplest possible, but the same arrangement will happen if we suppose that the superior half has turned a full half circumference.

Fig. 3.



These hemitropes are common in spinel, spinel ruby, and pleisto-magnetic iron.

There is another kind which is frequently witnessed in the oxide of tin. It consists of a four-sided prism, (fig. 4), terminated at each extremity by a four-sided pyramid, which, by

Fig. 4.

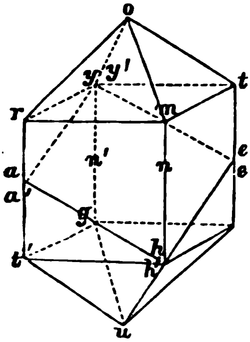
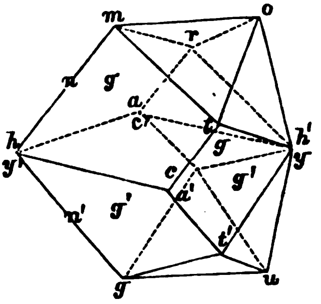


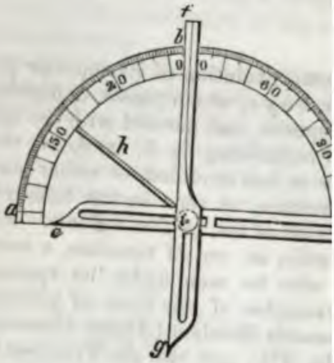
Fig. 5.



a transposition or demi-revolution of its superior portion, situated above the plane *a h y e*, which passes obliquely from one solid angle to the opposite, and parallel with the edge *o m*, has given rise to a form resembling fig. 5, excepting that the crystals are always more or less modified, or rather portions of the primary planes yet remain, as seen in the hemitrope crystal, under the species oxide of tin, in this volume. Similar combinations exist in rutile, an ore of titanium, a common example of which may also be seen under its appropriate head. For many other examples of this class of phenomena, illustrated by figures, consult Beudant (*Traité élémentaire de Mineralogie*, tom. i. edit. 2^{de}); and also the Treatises by Dana and Shepard. Dana makes a distinction, among these forms, into *Connatal* and *Postnatal* Compound Crystals, the first implying the union of the two crystals from the commencement of the crystallogenic process, as in the hemitropes of spinel and tin, just referred to, and the latter the union of the individuals sometime subsequent to their formation, and even after they have attained considerable size. The groupings of quartz crystals, like those from Herkimer, New York, belong to the latter, the combinations of which seem at first very irregular, and almost to have been tumultuously thrown together; but, on closer examination, it will be seen that the simple crystals among them are united so as to have their similar faces

compound forms, that may be consulted i
those already mentioned, are Harmotome
ite, Chrysoberyl, Carbonate of Lime, C
Hornblende, Carbonate of Lead, Carbo
Bournonite. The term *geniculated* is a
crystals which are united lengthwise, an
knee-shaped appearances, as observed in R
pressed as single or double, as we have
joints presented.

Common Goniometer.



Measurement of the Angles of

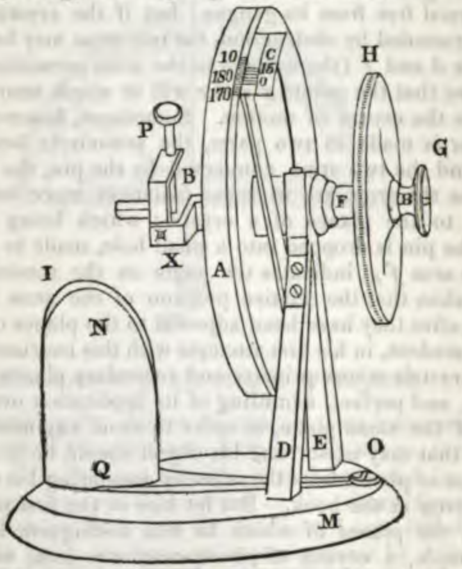
In determining the angles of crystals, tw
employed, called Goniometers, from γωνιῶν
of angles. The first and simplest is that in
geau. It consists, as represented in the a
brass or

beneath the arm *d e*, there is a plate of steel or of brass, which is attached to the semicircle near *c*, and extends somewhat more than half-way towards *a*, its termination being connected with the semicircle by the bar *h* for the sake of firmness: *i* is the head of a pin in the centre of motion, which is precisely midway between the two extremities of the semicircle *a c*, and at the same distance from *b* as from *a* to *c*. The pin passes through both arms and the brass plate; and on this pin the arm *f g* is at pleasure moved by the finger. The upper part of the arm *f g* cuts the semicircle, in the above figure, precisely at 90 degrees, expressed by 90°; if then two faces of a cube were presented to the lower portions of the two arms *g l* and *l e*, it would be found to fit them accurately, since the planes of a cube always meet each other at the angle of 90°. But if the solid be less or more than that angle, the instrument may be accommodated to the angle at which the two planes meet, by altering with the finger the movable arm *f g*, if applied near its termination *f;* and the value of the angle will be indicated by the edge of the movable arm.

As this goniometer is here figured, it is adapted to the planes of a crystal free from its gangue; but if the crystal be small and surrounded by obstruction, the two arms may be drawn by the ends *d* and *f* (the cavities in the arms permitting them to slide), so that the points *g* and *e* will be much nearer the pin which is the centre of motion. Sometimes, however, this goniometer is made in two parts, the semicircle being one of them, and the two arms, connected by the pin, the other. In that case the arms are in some instances more conveniently applied to the planes of a crystal; which being accurately done, the pin is dropped into a small hole, made to receive it, and the arm *f g* indicates the angle on the semicircle; care being taken that the relative position of the arms be not disturbed, after they have been adjusted to the planes of a crystal.

The student, in his first attempts with this instrument, should select crystals whose primary and secondary planes are large, smooth, and perfect, admitting of its application over different parts of the same plane, in order to avoid any minute irregularities that may exist; and his object should be to distinguish one class of planes from the other by comparing his results with those given in the book. But let him in the first place take a crystal, the planes of which he can distinguish beforehand, for example, a crystal of pleisto-magnetic iron, which exhibits portions of the planes of the octahedron and rhombic dodecahedron. He will observe that P on P will measure 109°, 28′, P on *e* 144°, 44′, and *e* on *e* 120°. (See large figure under this species.) Let him now pass to other more complicated forms, the planes of which he cannot distinguish beforehand, and endeavor to ascertain the two classes of planes by measurement, and by comparing his results with the figures given in the book. But he must remember that his skill in the use of the goniometer will depend on its precise adjustment to the planes of the crystal to be measured; for *unless the light be excluded from between the instrument and the crystal*, the adaptation will not be complete. If this cannot be accomplished, it may be concluded that the crystal, how perfect soever its planes appear, is not sufficiently regular to be relied on, if perfect accuracy be required. Even under the most favorable circumstances, and by those most experienced in the use of the instrument, we can obtain only approximations to the real value of the angles of crystals; and it was by relying solely on the results thus afforded, that many of Haüy's measurements have proved to be inaccurate.*

The *Reflecting Goniometer*, as invented by Wollaston, and improved by Sang, is a very superior instrument.



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* This is shown in the case of the rhomboid of calcareous spar, the angles of which, as given by Haüy, instead of being correctly stated at 105°, 5′, and 74°, 55′, are 104°, 28′,

A is a movable circle graduated on one edge to half degrees, and divided for convenience into two parts of 180 degrees each (it is graduated only in part in the above sketch).

C is an immovable brass plate screwed upon and supported by the pillar D, and graduated as a vernier.

F is the axis of the circle A, and passes through the upper part of two brass pillars D E, the lower ends of which are inserted into a wooden base M.

B is an axis enclosed within F, and turned by means of the smallest circle G, which communicates a motion to all the apparatus to the left of A, without, however, moving that circle.

H is a circle to which is attached the axis of the principal circle A. If, therefore, we would move the latter, it is done by turning H; and as the axis of the principal circle includes that of the apparatus on the left of it, the whole instrument is necessarily put in motion by moving the circle H.

L is a curved brass plate connected with the concealed axis B, and to which a motion is given by turning the small circle G; to L another curved plate is attached, but so as to admit of movement; and through the upper extremity of this last passes the pin P, which is so adjusted as to allow of being moved either up or down or circularly.

By means of the several motions thus obtained, a crystal attached to the lower extremity of the pin P may be brought as nearly as possible on a line with the axis of the instrument.

I is a small mirror made of some substance which does not give a very bright reflection: black glass or obsidian, for example. This is placed obliquely on a support N, at an angle towards the object of about 45°, immediately under the crystal (which in the present instance we shall assume to be a rhomboid of calcareous spar). The support is fixed to the wooden base M by a pin in the centre, which admits of its being turned for adjustment, and by a clamping screw O at the extremity of the arm Q O, which secures it in its proper position.

The use of this instrument depends on the reflecting power

40″, and 75°, 31′, 20″; and, as measured by Comte de Bournon, 101°, 32′, and 78°, 28′. It is added by Phillips, (Third Edition) that the common goniometer was perhaps never used by more skilful hands than by the authors named. Soon after the appearance of Mr. Phillips's celebrated paper on the measurements of oxide of tin, Haüy (*Annales des Mines*, 1818) candidly acknowledged the superiority of the reflecting goniometer, and admitted the inaccuracy of some of his former results; but, aided by a resort to theory, he was enabled to correct, as he supposed, many of his former measurements, in the determination of primary forms, and thus had the satisfaction of finding them to accord with those taken by reflection, while, at the same time, he continued to use the common instrument, which, he observes, "besides the advantage of its being direct and expeditious, suffices, whether the object be to determine a new variety, or to discover to which of those already classed in the method, a crystal presenting the form of either, and which we see for the first time, belongs." It has been shown that his theory, also, has led him into important errors. [AM. ED.]

of the polish on the natural planes or fractured surfaces of minerals, which, in some cases, is very powerful. In adjusting it, the image of any object seen by reflection from the face of the crystal, is made to agree with the image of the same object seen by the help of the mirror I. In this way any object may be selected which has a well-defined outline; while the goniometer, like the common sextant, may be held in the hand.

If a distant object, say the moon, be used, the coincidence of its two images will indicate that the face of the crystal is parallel to the mirror I, so that, if the two faces be brought successively into that position, the angular motion of the divided circle must measure the inclination of these faces. In this, it is essential that the plane of the mirror I be parallel to the axis of motion. Its adjustment is thus effected. Select a thin plate of any mineral, say calcareous spar, of which the opposite faces are parallel, and cement it to the lower extremity of the pin P; then bring the image of any distant object seen in one of its faces, to agree with that seen in I; turn the instrument half round, so as to bring up the opposite face. If the images agree now, the mirror is correctly placed; if not, one half of the apparent error must be corrected by releasing the clamp nut O, and turning the mirror on the pin at Q; the other half by the motions of P. A second, perhaps a third trial must be made, to ascertain the adjustment completely; but when this is once done, it need only be examined at long intervals, or after any accident.

The mirror having been thus adjusted, and the reflections in both the surfaces whose inclinations are to be measured having been brought to agree with it, we have now to observe that the line at 180° or 0 forms a line with that at 0 on the vernier, at the same time that the double reflection of the distant object in the mirror, and in one of the faces of the crystal, appear exactly to agree. One movement more, and the measurement is completed. Turn the circle H, until the reflection of the same object, as seen on the adjoining plane of the crystal, appears exactly to cover the image in the mirror, and it is done.

We now observe what line of the principal circle touches that at 0 in the vernier. Suppose that 105° on the former be now on a line with 0 on the vernier;—it is the value of the angle. But suppose it to be a little more than 105°, and less than 105½°, it must then be observed which line of the vernier touches, or forms but one line with, another line on the principal circle; suppose it to be 5° on the vernier; the angle is then 105°, 5′, which is the true value of the obtuse angle of a rhomboid of calcareous spar.

Mr. Sang's important improvement on Wollaston's goniometer consists principally in the apparently simple addition of the mirror I, which, however, renders it a vastly superior instrument, not only as regards precision and rapidity of measurement, but from its being readily used as a sextant, or rather as a repeating reflector, and thus enabling the expert mineralogist both to determine the angles of minute crystals, and to delineate the geographical features of the district which he may be exploring.

Of the comparative Value of the Common and Reflecting Goniometers.

The use of the common goniometer depends on two circumstances; one, the perfection of the crystalline planes; the other, the steadiness and accuracy of the hand and eye.

We are but little acquainted with the works of nature in her more hidden processes, amongst which may be reckoned crystallization; but it can be demonstrated beyond dispute, that the surfaces of large crystals are not so uniformly even, however brilliant they may appear, as the surfaces of small ones. Now the larger ones are best adapted for the use of the common goniometer; hence, if the crystal to be measured be not selected with the utmost care, and if the hand and eye be not steady and accurate, we cannot hope for precision in the use of it; we cannot expect that precision which ought to exist, since *this mechanical operation is to form the foundation for calculation.*

That the planes of small crystals are more perfect than those of large ones, is proved by the use of the reflecting goniometer, which depends on the perfection of these planes, and on their brilliancy. Even minute crystals, which generally are the most perfect, rarely agree in the angles they afford; but this disagreement is commonly *too small to be detected by the common goniometer;* a fact which clearly proves that its use cannot be relied on as a foundation for calculation. When, therefore, we would arrive at the greatest precision, we shall prefer the reflecting goniometer, and the reflections from the planes of minute crystals, in preferenee to those of large ones; but, above all, from planes produced by cleavage, whenever they can be obtained.

Now the surfaces produced by cleavage are sometimes very small, and therefore are not adapted to the common goniometer; while, for the reflecting goniometer, it matters not if the surface be small, provided it be perfect and brilliant; a surface of the 100th part of an inch in length and breadth will suffice.

In measuring the angles of crystals, it has been observed that great precision is essential, because the mechanical operation is a foundation for calculation; that is, for calculating the angles under which the secondary planes of a crystal meet each other; which, when once the first operation has been well conducted, is perhaps the shortest and most certain mode of arriving at the truth. In this the labors of the Abbé Haüy have shed over mineralogy a purely philosophical lustre, which indeed has been one of the chief causes of raising the study to the rank of a science: this he has done by showing the consonance of the laws of crystallization with rigid calculation: he has proved that in crystallization there is a *natural geometry*.

Varieties of Structure.

§ 56. Hitherto we have been treating chiefly of that structure which may be termed *perfectly crystalline;* this exists in such minerals as admit, in various directions, of regular cleavage. There are, however, other kinds of structure observable. In some minerals the natural joints are scarcely attainable, or, when attained, are only perceptible by the assistance of a microscope; in these the structure is said to be *imperfectly lamellar,* and this effect may be supposed to arise either from the brittleness of the substance, or from the strong cohesion existing between the laminæ. Such minerals may be said to be *imperfectly crystalline,* as may those also of which the planes obtained by cleavage are curved or undulating. It has already been observed, that some minerals are perfectly lamellar in one direction *only,* — the topaz, for instance; others cleave readily in one direction, with difficulty in another, as the sapphire.

§ 57. The *fibrous structure* which some minerals assume may in most cases be considered only as resulting from the close longitudinal adherence of small, or of extremely fine acicular crystals; for the terminations of the crystals are often observable on the exterior of the mass.

§ 58. Perhaps, also, under the head of Structure may be classed the variety of appearances assumed by the aggregation of small crystals. When merely collected, as it were, into a bundle, they are said to be *fasiculated;* when they are fasiculated, and diverge from a common centre, they are said to be *scopiform;* but when the divergence surrounds the centre, they are said to be *radiated,* or *stellated* — sometimes producing a starlike appearance. When, by radiating from a centre in all directions, a spherical or kidney-shaped form is produced, they are called *globular*, or *reniform*. The masses are called *Botryoidal* when in round shining prominences, like grapes, as often seen in hematite or calcedony: *Mammillary* when the prominences are larger.

§ 59. The term *slaty*, as it regards *structure*, is rarely applied to those minerals of which we have been treating, even when they are separable only in one, or at most two directions. This term is more commonly applied to such substances as consist of parallel layers which are thick and coarse.

§ 60. The *granular structure* arises from an aggregation of small particles, frequently of laminæ which separately are lamellar, intercepting each other in every direction. And in proportion to the fineness of these particles, a mineral is termed *coarse-grained* or *fine-grained*. If the particles are only perceptible with the aid of the microscope, the mineral is said to be fine-grained; but if the parts of which a mineral is constituted be not thus apparent, it is termed *compact*.

§ 61. The above modifications of structure, as has been hinted, arise principally from the form of the individual particles of which they are composed. These are termed *particles of composition*, and are supposed to be true crystals, which, by close contact, have been prevented from assuming regular forms. They are distinguished, according to their length, breadth, and thickness, by the terms *granular*, *columnar*, and *lamellar* particles of composition. The first is seen in common galena; the second in fibrous minerals, as asbestus; and the last in foliated minerals, as lepidolite. The difference between what has been called a *foliated* and *radiated* fracture, consists in that the first refers to granular particles, while the second is confined to columnar particles of composition.

Fracture.

An important part of this subject has already been considered under the head of structure; namely, that which treats of the geometrical forms into which some minerals may be cleaved; and the means (p. xxix) of attaining this have been adverted to.

But when such minerals as may be mechanically divided along their natural joints are broken in directions contrary to those joints, the surfaces so produced are not plane; they are said to be *conchoidal* when the surface more or less resembles the appearance of a shell; thus we have the perfect, imperfect, large, small, and flat conchoidal. These varieties of fracture also exist in minerals which appear not to possess any regular internal structure. There are also other kinds of fracture; as the *even*, when the surface is nearly flat; the *uneven*, when it is not flat; the *splintery*, &c. The faces thus separated are called *faces of fracture*, in contradistinction to the *faces of crystallization*, and to those faces produced by separation parallel with the natural joints of the crystal, called *faces of cleavage*, both of which have already been described.

When crystals closely united are separated from each other, the faces thus developed are termed *faces of composition.* They may readily be distinguished from the other faces by their dull, uneven surfaces, except in the cases of minerals composed of lamellar particles of composition, in which, by the juxtaposition of similar planes, the laminæ happen to be disposed in the same direction, and separate smoothly. This is often the case in crystals of heulandite and apophyllite, in which, however, if a portion of either of the two faces which had been united is cleaved off, the distinction will be made manifest. Faces of fracture can hardly be mistaken for them under any circumstances.

Frangibility.

The frangibility of some minerals may in a measure be said to depend upon their structure; in all, it is probably dependent on some peculiarity in the arrangement of the molecules or particles of which a mass or crystal is composed. From whatever cause it proceeds, this quality varies greatly in different substances, ranging through all the intermediate degrees, from *very brittle* to *very tough.* It cannot in all cases depend on the chemical composition of a species; for some substances which are very different in their frangibility, have very nearly the same chemical composition. This is seen particularly in the new mineral of Mr. Cornell, called Dysclasite, which is nearly allied to thomsonite or mesotype in its composition, but which has almost the toughness of a malleable metal when we attempt to break it.

Some few minerals, as sulphur, are so brittle that a fragment is easily detached by the pressure of the nail on the edge of a broken surface; but as this may be produced in any direction, it cannot be said to depend on the structure of the substance.

The laminæ of selenite are readily separable in one direction; and, if very thin, are brittle in another direction; while in the same, if the specimen be a line or more in thickness, it is tough; heavy spar is easily frangible in every direction; so also are calcareous spar and fluor. But frangibility, strictly speaking, ought not to be considered as connected with the ease or difficulty with which minerals yield in directions parallel to their natural joints: it seems rather applicable to their property of yielding to mechanical force in other directions. If this quality depended on regular cleavage, we should say that corundum is very brittle, because it yields along its natural joints with ease; and we should characterize the diamond as moderately brittle, because it can be cleaved with but little force; but in contrary directions these substances are far removed from either brittleness or toughness.

Sulphur and the sulphate of lead are very brittle; carbonate of lead, red silver, grey copper, and others, are moderately brittle, and easily frangible in every direction. From these, fragments are readily detached by the pressure of the knife; other minerals yield only to a blow with the hammer; others, again, are said to be tough, because, instead of breaking, their particles only yield to the force, and, by sliding, as it were, over one another, suffer depression without producing fragments. Granular selenite is considerably tough; massive hornblende is very tough. In using the hammer, it will be found that a smart blow from a small one will produce more effect, and better surfaces, than a heavy blow with a large one.

It may be observed that most of the porous minerals, and perhaps there are few which are not so, are much more frangible when first taken from their native bed than after exposure. Of this, common flint, in which no regular structure has been observed, is a remarkable instance. This circumstance is doubtless owing to the water which fills its pores when in its native place, but which evaporates on exposure.

Hardness.

Hardness is a very useful property in determining minerals; and we are indebted to Professor Mohs for a scale easily formed, and, at the same time, distinct and accurate.* The means of applying it also are within the reach of every mineralogist. It consists of

1. *Talc*, of a white or greenish color.
2. *Rock-salt*, a pure cleavable variety; or gypsum uncrystallized, and only semi-translucent.

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* The method here alluded to, of denoting hardness by numbers, is due to an earlier mineralogist, Kirwan, who constructed a scale somewhat similar to it, as may be seen in his Mineralogy, vol. i. p. 38. [Am. Ed.]

3. *Calcareous Spar*, any cleavable variety.
4. *Fluor Spar*, presenting good cleavage.
5. *Apatite*, the Asparagus Stone from Saltzburg.
6. *Adularia*, any perfectly cleavable variety.
7. *Rock-crystal*, limpid and transparent.
8. *Topaz*, any simple variety.
9. *Sapphire*, which affords smooth cleavage planes.
10. The *Diamond.*

As the degrees of hardness between 2 and 3, 5 and 6, are not proportionate to the other numbers, Breithaupt has improved the scale by introducing between these numbers two additional expressions, which Dana has employed so as not to increase the number of units of comparison. Thus, foliated mica, 2·5; scapolite, 5·5; Breithaupt's scale consists of whole numbers, or of *twelve* individual minerals, whose degrees of hardness regularly increase.

In employing the above scale, we endeavor to find the degree of hardness of a given mineral by trying which number of the series is scratched by it; or, still better, by passing with the least possible force the specimens under comparison over a very fine file. Every person will observe a marked difference on comparatively trying in this way any two consecutive numbers of the above scale, and by a little experience he will soon acquire the manual skill necessary for nice discrimination.

From the resistance these bodies afford to the file, from the noise occasioned by their passing over it, and from the quantity of powder left on its surface, their mutual relations in respect to hardness are deducible with great correctness. When, after repeated trials, we are satisfied which member of the series our mineral is most closely allied to, we say its hardness (suppose it to be calc-spar) is equal to 3, and write after it H. = 3·0. If the mineral do not exactly correspond with any member of the series, but is found to be between two of them, we say H. = 3·5, or 3·75, if it approximate to the higher number. Care, however, must be taken to employ specimens of each which nearly agree in form and size, and correspond as much as possible in the shape of their angles. They must likewise possess perfect purity, as the degrees of hardness can no more be correctly ascertained than the specific gravity, if impure substances are made use of. The file required for this purpose should be cut fine, and, if possible, of the hardest steel. The latter property, however, is of less moment, as it is not the hardness of the tool with which we are to compare that of the mineral, but the relative degrees of hardness of minerals, which are to be ascertained through the medium of the file. *(Introduction to Allan's Manual.)*

Transparency.

This is not an essential physical character, inasmuch as the degree in which light is transmitted through a mineral often varies greatly in the same substance, and even in the same specimen. In description, however, a mineral is said to be *transparent* when objects can be distinctly and clearly perceived through it, *semi-transparent* when they are imperfectly seen, *translucent* when they are scarcely or not at all visible; but when, from various causes, a mineral appears not to suffer the transmission of light, we may perceive, on holding it between the eye and the light, that it is *translucent on the edges*; when this does not exist, the substance is termed *opake.*

Lustre.

Lustre is a character of considerable importance. It is of several kinds; and the same lustre which a mineral presents *internally* is usually exhibited throughout the species, although in crystallized substances it often differs very much *externally,* even on the same specimen.

That which is peculiar to the metals in their pure state is termed the *metallic lustre;* this belongs chiefly to opake minerals, such as plumbago, among amorphous substances; and specular iron and grey copper, among those which are crystallized; but this kind of lustre is not equally intense in all those minerals which possess it, inasmuch as it varies from shining to dull. In some minerals, however, there is a species of metallic lustre which is perceptible only when the substance is held towards the light in some particular direction, as in bronzite; it is then termed *pseudo-metallic.*

Adamantine lustre will be better understood by a reference to those substances to which it belongs, than by any description. It exists in the diamond, some varieties of corundum, in sulphate of lead, &c. It belongs only to such species as possess a greater or less degree of translucency, and, being dependent on their capabilities of reflecting and of refracting light, it is supposed in some degree to depend on their structure.

Pearly lustre, more or less distinct, is peculiar to several species, though sometimes only in a particular direction; it rarely exists but in lamellar minerals.

is believed to arise from fine fibres of asbes
included in it. But no adequate cause has
that changeable play of light so beautifully d
stone and chrysoberyl, or the still more b
noble opal and labradorite.*

The *resinous lustre* in minerals resembles
servable on the fractured surfaces of resins;
hibits that of broken glass: these belong chie
produced by fracture in directions contrary
laminæ, if the mineral possess regular struct
ties of pitchstone are instances of resinous, c
lustre. *Waxy* lustre is observable in leelite,
surfaces of which possess that lustre which
wax: it is rarely, if ever, observable where r
exists.

When no particular lustre is observable,
arises from the mere polish of the natural surf
produced by fracture, a mineral is described
intensity, as being *splendent*, *shining*, *glisteni*
ing; but a glistening or glimmering lustre o
from the fractured surfaces of some minerals,
those surfaces are uneven, and consist of mi
disposed planes, from which the light is unequ

In the absence of lustre, a mineral is describ

System of Colors.

Color is also a character of considerable in
discrimination of minerals, and it was one of
pal characters on which Werner relied in esta
But it is impossible for the memory to retain,
nize, all the numerous subdivisions which hav

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* Dr. Brewster, to whom we are so largely indebted

it by various authors to express the ever-varying hues which we discover in mineral bodies. Not even in a single species, if we except the metals and metallic oxides, can it be said to possess any uniform shade, since the emerald itself, in which it is supposed to be characteristic, exhibits several varieties of the same color. And it would obviously be absurd to quote color in fluor spar as one of the most characteristic methods of making it known to the student, as scarcely two specimens can be found in which it agrees. The same is nearly true of amethyst, in which the oxides of iron and manganese are accidentally diffused through quartz, of which it is a variety. In other instances we have varieties of a mineral under names very different from that of the mineral itself, merely from the color, as in prase as a variety of quartz, chrysophrase of calcedony. The color of the former is by some supposed to arise from an intimate mixture of another substance in the mass; that of the latter is derived from a metallic oxide; and these oxides are the principal coloring matter of earthy minerals, the earths being all white and colorless when chemically produced in a pure state.

When a crystallized mineral includes a metallic oxide, or any other substance which produces *no alteration in the crystalline forms* assumed by the mineral in its pure state, such an ingredient, whether it be the coloring matter or not, is considered to be only accidental, as in the instances just mentioned.

In some of the metalliferous ores, however, where it depends on the nature of the mineral, and is therefore nearly uniform, color constitutes a very important characteristic.

Werner described all minerals under eight colors which he called fundamental, and divided into two classes, Metallic and Non-metallic. The late Professor Mohs has given a systematic arrangement of them in his Treatise on Mineralogy, which, in an abridged form, selecting the most characteristic, will be here adopted. Taken as a whole, many of them would seem so nearly alike as to be of no essential practical use.

The Metallic colors are:

1. *Copper-red.*
2. *Bronze-yellow.*
3. *Brass-yellow.*
4. *Gold-yellow.*
5. *Silver-White.*
6. *Tin-white.*
7. *Lead-grey.*
8. *Steel-grey.*

The Non-metallic are the following:

WHITE.

1. *Snow-white.* Ex. pure White Marble; Carrara Marble.

2. *Reddish-white.* Ex. several varieties of Carbonate of Lime and Quartz.

3. *Yellowish-white.* Ex. several varieties of Quartz.

4. *Greyish-white.* Ex. Granular Limestone and Common Quartz.

5. *Greenish-white.* Ex. Common Talc.

6. *Milk-white*, white somewhat blue. Ex. Common White Opal and Calcedony.

GREY.

1. *Bluish-grey.* Ex. Splintery Hornstone.

2. *Pearl-grey*, grey mixed with red and blue. Ex. Sulphate of Barytes and Horn Silver.

3. *Smoke-grey*, grey mixed with brown, the color of thick smoke. It is seen in Flint.

4. *Greenish-grey.* Ex. several varieties of Quartz, Cat's-eye, &c.

5. *Yellowish-grey;* may also be seen in Flint.

6. *Ash-grey*, a mixture of black and white. Ex. Zoisite.

BLACK.

1. *Greyish-black.* Ex. Basalt; Lydian Stone.

2. *Velvet-black*, the purest black color. Ex. Obsidian, Tourmaline, or Schorl.

3. *Greenish-black.* Ex. varieties of Augite.

4. *Brownish-black.* Ex. Bituminous Coal.

5. *Bluish-black.* Ex. Earthy Cobalt.

BLUE.

1. *Blackish-blue.* Blackish-blue. Ex. dark colored varieties of Carbonate of Copper, or Malachite.

2. *Azure-blue*, bright blue mixed with a little red. Ex. pale varieties of Malachite, and bright varieties of Lapis Lazuli.

3. *Violet-blue*, blue mixed with red. Ex. Amethyst and Fluor.

4. *Lavender-blue*, blue with a little red and much grey. Ex. Lithomarge and Porcelain Jasper.

5. *Plum-blue;* seen in some varieties of Sapphire or Corundum.

6. *Prussian-blue*, the purest blue color. Ex. brightest varieties of Sapphire and Disthene.

7. *Smalt-blue.* Ex. varieties of Gypsum.

8. *Indigo-blue.* Ex. Phosphate of Iron, or Vivianite.

9. *Duck-blue.* Ex. Ceylanite.

10. *Sky-blue.* Ex. Sulphate of Strontian.

GREEN.

1. *Verdigris-green.* Ex. Amazon Stone, or Green Felspar.
2. *Cylandine-green*, green mixed with blue and grey. Ex. Green Mica, and varieties of Talc and Beryl.
3. *Mountain-green*, green with a large portion of blue. Ex. Emerald, and varieties of Beryl.
4. *Leek-green*, green with a little brown. Ex. very distinct in Prase.
5. *Emerald-green*, the purest green color, as seen in Precious Emerald.
6. *Apple-green*, light green with a trace of yellow. Ex. very distinct in Chrysoprase.
7. *Grass-green.* Ex. very distinct in Green Diallage and Phosphate of Uranium.
8. *Pistachio-green.* Ex. Chrysolite.
9. *Asparagus-green.* Ex. varieties of Fluor Spar and Phosphate of Lime, or Apatite.
10. *Blackish-green.* Ex. varieties of Serpentine.
11. *Olive-green.* Ex. Olivine, Green Garnet, and Pitchstone.

YELLOW.

1. *Sulphur-yellow.* Ex. Pure Sulphur.
2. *Straw-yellow.* Ex. varieties of Topaz.
3. *Wax-yellow.* Ex. Molybdate of Lead and Common Opal.
4. *Honey-yellow.* Ex. Carbonate of Lime and Fluor Spar.
5. *Lemon-yellow*, purest yellow color. Ex. Sulphur and Oxide of Uranium.
6. *Ochre-yellow.* Ex. variety of Jasper.
7. *Wine-yellow.* Ex. Saxony Topaz.
8. *Orange-yellow.* Ex. Molybdate of Lead, from Hungary.

RED.

1. *Aurora-red*, red with much of yellow. Ex. some kinds of Native Sulphur.
2. *Hyacinth-red.* Ex. Zircon and Hyacinth.
3. *Blood-red.* Ex. variety of Garnet called Pyrope.
4. *Flesh-red.* Ex. variety of Analcime.
5. *Rose-red.* Ex. Rose Quartz.
6. *Peachblossom-red.* Ex. Sulphuret of Cobalt and Lepidolite.
7. *Cherry-red.* Ex. Purple Sulphuret of Zinc.
8. *Brownish-red.* Ex. Red Chalk or Reddle, and Jasper.

BROWN.

1. *Reddish-brown*, brown mixed with much red. Ex. Blende and Zircon.

2. *Clove-brown.* Ex. very distinct in Axinite, and in varieties of Smoky Quartz.

3. *Hair-brown*, brown with a little yellow and grey. Ex. Wood Opal.

4. *Chesnut-brown.* Ex. Egyptian Jasper.

5. *Yellowish-brown*, brown with a great deal of yellow. Ex. Common Iron Jasper.

6. *Wood-brown*, brown with yellow and grey, the color of rotten wood. Ex. varieties of Augite.

7. *Blackish-brown*, brown with a great deal of black. Ex. Mineral Resin and varieties of Bituminous Coal.

It is to be understood that the color of a mineral is determined by observing the *interior* surface presented by a *fresh* fracture. The intensities of color are denoted by the terms dark or deep, light or pale. When a crystal is perfectly clear and transparent, it is said to be colorless.

Flexibility and Elasticity.

Flexibility serves as one among the distinctive characters of the few minerals which possess it. That substance is said to be flexible which, being bent, does not of itself resume its former shape, but continues in the form forcibly given to it. Talc is flexible, as is the Cornish phosphate of iron; while that of New Jersey is brittle. Those minerals, on the other hand, are termed elastic which, after being bent, spring back to their former position. Mica is very elastic, and may by this character alone be distinguished from talc, which is only flexible.

Double Refraction.

Recent discoveries have so widely extended our information on this subject, that any adequate explanation of its details would be quite unsuitable in this place. But the subject may be made to call forth the interest of the student by a few illustrative examples of double refraction, as exhibited by transparent carbonate of lime, or Iceland spar. Select a transparent rhomboid of this mineral, and place it, resting on its terminal plane, over a black line on white paper. On looking through it, in all directions excepting that which is parallel with its shorter diagonal, a double image will be observed: — one by the usual refraction of the light, and the other by an extraordinary refraction. If the crystal be now turned around, the latter image will appear to revolve on the former. If placed over a cross in the direction of its longer diagonal, the horizontal line of the cross will appear as in fig. 1. If turned 45°, the image will appear as in fig. 2. If turned again 45°, it will appear as in fig. 3. If again turned 45°, we have the same figure as that produced by the first revolution (fig. 2). If now carried to the full half circle, we again produce the first figure of one perpendicular, and two horizontal lines; and if carried through the whole circle, all the same phenomena are repeated, the final view of the cross appearing like the first figure. In all doubly refracting bodies, there are one or more lines or planes, along which there is no double refraction, or, in other words, where the ordinary and extraordinary rays coincide, as in the direction of the shorter diagonal of calcareous spar, just referred to. This gives rise to the term *axes of double refraction*, and calcareous spar is therefore said to have one axis of double refraction. As the ray of light which suffers extraordinary refraction, is refracted *from* the axis, Iceland spar is said to have a *negative* axis of double refraction. But in a crystal of quartz it is refracted *towards* the axis, and this is said to have a *positive* axis of double refraction. The existence of this positive axis in quartz, was first noticed by M. Biot, and was called by him the *attractive* axis, to distinguish it from the other, which he called the *repulsive* axis.

Fig. 1.

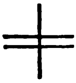


Fig. 2.

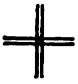


Fig. 3.

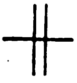
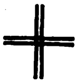


Fig. 4.



From the examination of a great number of crystallized minerals, Dr. Brewster has discovered that those which have *one axis* of double refraction belong to the *rhomboid*, the *regular hexahedral prism*, the *octahedron with a square base*, and the *right prism with a square base;* while the great body of crystallized substances, mineral or chemical, have *two axes* of double refraction, and are comprised under these primary forms, viz: the *right prism* with its base a rectangle, a rhomb, or an oblique parallelogram; the *oblique prism*, with its base a rectangle, a rhomb, or an oblique parallelogram; or the *rectangular* and *rhomboidal octahedron*. These are comprised under the prismatic system of Mohs.

The connection between double refraction of light, and the polarization of its rays, has opened a wide and most instructive branch of research, and is calculated to have a most important application to mineralogical science. It has engaged the attention of some of the most eminent philosophers of the age, as Biot, Herschel, Brewster, Fresnel, Malus, and Mitscherlich. But we are especially indebted to Brewster and Fresnel for the discovery of those more extraordinary phenomena which have an immediate mineralogical bearing, and particularly for those which characterize the crystals of analcime, apophyllite, glauberite, and quartz. Nothing can be more beautiful than the single and double systems of colored polarized rings, attended by their central crosses, which the former has discovered in the single and biaxial crystals of various other minerals and artificial bodies, all of which have been so ably and fully illustrated, and the laws to which they are subject explained, in his numerous papers published in the *Philosophical Transactions*, the *Edinburgh Transactions*,* the *Edinburgh Journal of Science*, the article OPTICS in his *Encyclopedia*, and that of POLARIZATION in the *Supplement to the Encyclopedia Britannica*. To these, and the two numbers of the *Library of Useful Knowledge*, in which the subject is very familiarly treated, the reader is referred. He may also consult with much advantage the introduction to *Allan's Manual of Mineralogy*, where the structure of minerals is described in reference to their double refraction.

Touch.—Taste.—Odor.

The touch, or *feel*, is very characteristic in a few minerals. Soapstone is *unctuous* to the touch. Chalk is said to be *meagre*, being dry and without absolute harshness. It is principally in these two respects that this character is used in description.

Taste is employed as a discriminating property in most saline minerals, of which water is a solvent; in this case the palate may be resorted to as a test of their nature, and the following expressions be employed:

1. *Astringent* for the taste of vitriol.
2. *Sweetish* for the taste of alum.
3. *Saline* for the taste of common salt.
4. *Alkaline* for the taste of carbonate of soda.
5. *Cooling* for the taste of saltpetre.
6. *Bitter* for the taste of Epsom salt.
7. *Urinous* for the taste of sal ammoniac.
8. *Sour* for the taste of sulphuric acid.

The odor of a mineral is a character of very restricted use. When swinestone is struck forcibly, or rubbed against another and a harder substance, it emits a peculiarly fœtid odor; and some argillaceous minerals give out a smell of clay when breathed upon. Iron pyrites emits a sulphurous odor when strongly rubbed, and arsenical pyrites, under the same circumstances, emits the odor of garlic.

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* Philosophical Transactions from 1813 to 1818; Transactions of the Royal Society of Edinburgh, vols. vii., viii., ix., and x.

Streak.

This is a very important character. The color of a mineral and that of its powder are frequently different; and as the particular hue of the latter is most easily obtained by rubbing or *streaking* the specimen under examination on a slab of porcelain biscuit, the color of the powder of a mineral is thence denominated its streak. The streak of white minerals is usually white, that of colored ones paler than the mass; but when it corresponds with the color of the mineral, it is said to be *unchanged.* This is a more constant property than color, and among the metals (the two species of magnetic ore, for instance) is perfectly characteristic.

Adhesion to the Tongue.

This character depends on the disposition of a mineral to imbibe moisture. Lithomarge adheres strongly to the tongue, as do some substances which are supposed to be in a state of decomposition, as several varieties of calcedony and opal.

Magnetism.

This character is confined, with little exception, to some of the ores of iron, amongst which there are very perceptible degrees of difference in their power of attracting the magnet; dependent on their several states of oxidation, or upon their being constituted of iron differently oxidized. Oxidulated iron is strongly magnetic, and possesses *polarity;* the specular is magnetic in a less degree; and red hematite is sometimes feebly so. Carbonate of iron is considerably magnetic. Iron, cobalt, and nickel, are the only metals which possess magnetism; and whenever other substances possess this property, it arises from the presence of iron.

A common magnet has two poles, a north and a south. If the north poles of two magnets be brought in contact, they repel one another, and the same effect ensues if the south poles are presented together. But the north pole attracts the south pole, and the south the north; and hence, when a mineral is presented to the magnet, which attracts the one and repels the other, it is said to possess *polarity.*

But in order to determine this point, it is advantageous to employ a needle of feeble power; for if the magnetic power of the needle be greatly superior to that of the mineral, the latter will attract both poles of the magnet; which has been explained in this manner: it is said that the superior power of the needle produces in the mineral a polarity contrary to its own. Haüy rendered very small degrees of magnetic attraction in minerals evident by the following method, or by what has been called *double magnetism*. When the magnetic needle is suspended on its point, and has taken its position in the magnetic meridian, a magnet is placed at a certain distance from it, its north pole, for instance, being opposed to the north pole of the needle. The magnet is now brought towards the needle, until, by the mutual repulsion of the similar poles, the needle has taken a direction perpendicular to that which it had at first. The repulsion of the magnet is now in equilibrium with the magnetism of the earth, and the least force acting on the needle will overcome it. According to the observations of the late Col. Gibbs, it appears that light has great influence on the magnetic property of protoxide of iron, as it exists in the mine; for he found the upper parts to be magnetic, and to possess polarity, while the lower parts showed no magnetism until after exposure to the atmosphere and light. Werner is said to have observed the same.

Electricity.

It will be recollected that there are two kinds of electricity, which are called *positive* and *negative*, or vitreous and resinous, according as they are produced by exciting smooth glass, or any resinous substance. It will also be recollected, that when two bodies possess the same kind of electricity, whether positive or negative, they repel each other; but if one possess positive electricity and the other negative, they attract each other.

A considerable number of minerals may be rendered electric by friction with the hand or woollen cloth; and when thus excited, they are capable of attracting light bodies, or of moving a delicate electrometer.

Among the minerals which are capable of exhibiting electric properties, there are a few which acquire electricity by being *heated*, either by simple exposure to a fire, or by immersion in hot water. But those substances which are excited by heat, acquire at the same time both positive and negative electricity; but so separated that, on whatever part of the mineral the positive may appear, the negative will be found on the part diametrically opposite. Thus, if positive electricity appear on one side, or at one extremity of a crystal, negative electricity will exist on the opposite side, or at the other extremity. And it is very remarkable that, in crystallized minerals, excitable by heat, the opposite parts of the crystal on which the two electricities appear, are almost always different from each other in their configuration, or number of sides, although similarly situated in reference to the crystal itself. Thus, if it be a prismatic crystal of tourmaline, and if the two electricities appear at the two extremities or summits of the prism, these two summits will differ from each other in the number or situation of their planes.* Most frequently that part of the crystal which possesses positive electricity presents the greater number of faces; and, on the contrary, when a crystal does not become electric by heat, the opposite parts are usually similar. Sometimes certain angles or faces possess positive electricity, while the opposite angles or faces exhibit negative.

It may be stated as a general fact, with very few exceptions, that earthy minerals and salts, possessing a considerable degree of purity, and having their surfaces polished, acquire positive electricity; but if their surfaces are not smooth and polished, they acquire negative electricity, as is the case with rough glass.

Combustibles, the diamond excepted, become negatively electric by friction. The diamond, whether polished or unpolished, always becomes positive.

The Metallic ores are usually conductors of electricity, with the exception of some metallic salts, which become positive by friction. The influence of electricity in *producing* crystals, and even entire veins of metallic bodies in their rocky repositories, has not until recently been investigated; but we are now presented with very convincing proofs of such an influence.†

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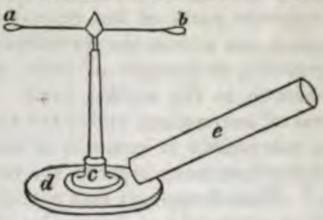
* The different configuration of the opposite parts of a crystal, exhibiting the two kinds of electricity, has been supposed to be a uniform fact. But more extensive observations seem to show that it is not always the case. Some tourmalines from Pegu and Ceylon, which possess both electricities, appear to have both summits perfectly regular and similar. Another exception appears in the dodecahedral crystals of boracite. (Bournon, quoted by Cleaveland.)

† For these we are indebted to the experiments of Fox, Becquerel, and others, by which it is made to appear that these veins, &c. owe their origin in many cases to the electrical or electro-chemical agency exerted while the metals were held in solution by the saline waters which percolate the rocks, depositing their contents according to the electro-positive or electro-negative relations subsisting between them and the rock. By an ingenious artificial contrivance, imitating the conditions which are supposed to exist in nature, they have produced crystals of native copper, of red oxide of copper, and various oxides and sulphurets, exactly like those which are found deposited in the regular mineral veins. These results most happily explain several hitherto anomalous facts in the phenomena of mines, which are noticed by De la Beche, in his Geological Survey of Cornwall, Devon, &c. pp. 380, *et seq.* [AM. ED.]

For observing the electricity of minerals, the electrometer is the most convenient instrument.

In this figure, *a b* is a needle of copper, terminated at each extremity by a small ball, and moving very easily on a pivot at the centre. At *c* the instrument has a metallic base. If a mineral which has been excited, either by friction or heat, be presented near to one of the balls, the needle turns, whether the electricity be positive or negative; and the force of the electricity may be estimated by the distance at which the needle begins to move.



To determine which kind of electricity a mineral possesses, the needle must previously be electrified, either positively or negatively; which may be done in the following manner. Let the instrument be insulated by placing it on *d*, a plate of glass or resin. Having excited a tube of glass, or a stick of sealing-wax, place one finger on the metallic base *c* of the electrometer, and then bring the excited glass or sealing-wax *e* within a small distance of one of the balls of the needle. When the needle is sufficiently electrified, first withdraw the finger, and then remove the glass or sealing-wax. If now an excited mineral be presented to the needle, they will repel or attract each other, according as they possess the same or opposite kinds of electricity. But as the electricity of the needle is known, that of the mineral may be determined.

To ascertain the electric poles, or those parts of a crystal which possess contrary electricities, let a thread of silk about one fourth of an inch in length be connected to one extremity of a rod of sealing-wax, which must then be excited. To this thread of silk, which of course is negative, let the sides, angles, or summits of the mineral under examination be successively presented; and the attraction or repulsion observed will indicate those parts of the crystal where the two electricities reside.

Sealing-wax, when rubbed by most minerals, becomes negative. There are, however, a few minerals, of which sulphuret of molybdena is one, which, being rubbed on sealing-wax, communicate to it positive electricity. In these experiments both the wax and mineral should possess smooth surfaces of considerable extent. (*Cleaveland's Mineralogy*, second ed. p. 65.)

Phosphorescence.

This is a curious property rather than a useful character in the few minerals which possess it. A mineral which emits a light, either by heat or friction, or exposure to the sun, is said to be phosphorescent. Fluor, and particularly that variety of it termed chlorophane, is an instance of the first, and a variety of blende of the last; if two pieces of quartz, or of the calcareous spar from Huel Goet in Brittany, be rubbed together, they emit sparks of light.

This character is of the less importance, because it does not seem to be essential to all such minerals as possess it even in the greatest degree; for, according to Bournon, some varieties of fluor are not phosphorescent.

The light emitted by phosphorescent substances is extremely variable in respect of color. The best mode of exhibiting it in those which become so by heat, is by first pounding them, and then ejecting the powder on a shovel not quite red hot, in a dark room. Whatever color a phosphorescent mineral may possess, it is generally lost by repeatedly subjecting it to heat; and the property of phosphorescing is also gradually diminished, and ultimately destroyed.

This property, however, does not appear to be dependent on color, or even connected with it, since the most perfectly colorless and transparent fluor, when powdered and thrown on live coal, emits a brilliant blue light.

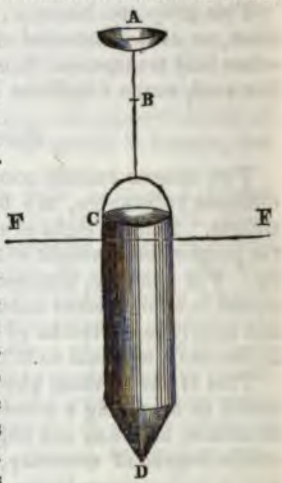
Specific Gravity.

Two masses exactly corresponding in size, but consisting of different substances, are found in most cases to disagree in weight. If the weight of one of these be considered as unity, the proportional weight of the other is termed its specific gravity. For example, suppose a cube of water to weigh exactly a pound, a similar-sized cube of calc-spar will weigh two pounds and nearly seven tenths of a pound, a sum which is represented in decimals as equal to 2·7.

This is one of those physical properties which are extremely useful in acquiring a knowledge of the inorganic productions of nature, as it can not only be easily ascertained to a considerable degree of accuracy, but is constant, or at least ranges within very narrow limits, in minerals of the same species.

The instruments used for ascertaining the specific gravity of solid bodies, are the hydrostatic balance and the areometer. The former allows of very high degrees of accuracy, and is most conveniently used in the following manner: — One of the scales of a very fine balance being elevated considerably above the other, a small hook is attached to its lower surface, from which a watch-glass is suspended by means of a hair or a fine fibre of silk. The mineral is then placed in the watch-glass, and along with it immersed in water. Thus the difference indicated in the weight of the mass, before and after its immersion in the fluid, amounts to the weight of the quantity of water displaced by the bulk. When an experiment is to be performed, this glass is immersed in water, and the weight of the specimen placed in the elevated scale first ascertained. For instance, a piece of metal is found to weigh in the elevated scale 2·645 grains; but when put into the watch-glass and immersed in water, its weight amounts only to 0·295 grains. Then, as 0·295 is to 2·645, so is unity to the specific gravity of the metal, which in this case will be found to amount to 8·966.

The delicacy of the hydrostatic balance occasions it to be affected by the slightest current of air, and it therefore requires, when used, to be enclosed in a glass-case. For this reason, in performing common experiments, and in most cases for obtaining the required results with quite sufficient accuracy, the areometer will be found preferable. This instrument has also the advantage of cheapness and portability. Its form resembles the accompanying figure. The body consists of a hollow cylinder or tube, the lower portion of which terminates in a point. A certain quantity of lead is melted into the bottom of this at D, so as to give it, when placed in water, an upright position, and admit at the same time of a portion of the cylinder rising above the surface, as may be supposed to the line F. Weights are then placed in the cup A, until the whole instrument is depressed in the water to the point B, marked upon the wire index which supports the cup. This gives the normal or standard weight. The mineral under examination is



then placed in the cup A, and so much of the weight at the same time removed from it, as to raise the whole again to the index-point B, marked on the wire. By this means the actual weight of the specimen is obtained; but when it is removed from the cup A, and placed on the top of the cylinder, which is a little hollowed at C, the instrument will be found to rise considerably in the water, and a certain weight will then be requisite to depress it to the above-mentioned point B. This last weight then is required to counterbalance the loss sustained by the mineral in water, and is equivalent to the weight of the volume of water displaced by the mineral. The *second* weight subtracted from the *first* or normal weight, leaves the absolute weight of the mineral; the *second* weight deducted from the *third*, leaves the weight of an equal volume of water; and from these results, as on the former occasion, the specific gravity of the mineral may be reckoned. The normal weight, for instance, is twenty grains; that is, it requires 20·000 to depress the instrument to the point B. Suppose the same piece of metal as in the former experiment to be used: it is placed in the cup A along with 17·355 grains, in order to bring the instrument to the same depth. When removed from the cup A to that at C, 17·650 grains are found requisite to produce the same effect. And now, to find the specific gravity, divide 20·000 — 17·355, or 2·645, by 17·650 — 17·355, or 0·295, from which, as in the foregoing case, the specific gravity of the mineral will be found to amount to 8·966.

A considerable degree of attention is necessary, both in selecting the specimens, and in performing the operation of weighing. The minerals intended for examination require to be perfectly pure; and, previous to commencing, the greatest care must be taken to remove whatever foreign matter may adhere to the specimen. All the vacuities or empty spaces are to be carefully opened, or the mineral broken down, not into powder, but into fragments; and distilled water must be used, of a temperature not differing much from 60° Fahrenheit. When the mineral, during the process, is supposed to have absorbed water, the weight of what is imbibed may be ascertained by again weighing the mineral in air, and adding the amount to the first term of the proportion, or, what will generally suffice, it may be varnished before being subjected to such examination.* (*Introduction to Allan's Manual.*)

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* Fluid minerals, and those lighter than water, are few in number, and rare. For methods of obtaining their specific gravity, reference may be had to the Treatise on Chemical Manipulation, by Faraday.

Pseudomorphism.

When the crystals of one mineral assume regular imitative shapes of the crystals of another, and in consequence of the disappearance of the latter, the places of which they now occupy, they are said to be *pseudomorphous*. They may have been formed within cavities left after the occupants of them had been removed, or upon other crystals, which, being more liable to decomposition, have subsequently disappeared. The latter is probably by far the most common mode of their formation. But there is still another not unfrequent source of these pseudomorphs, founded on the gradual replacement of the particles of one mineral by those of another possessing some resemblance to it in chemical constitution. Thus Oligisto-magnetic Iron, the primary form of which is a rhomboid, has been observed in the regular octahedrons of Pleisto-magnetic Iron. Here the octahedron, without any change of external form, has assumed the character of a new species by the additional oxidation of its iron, the whole becoming peroxide. The oxides or salts of one or two other metals, besides several earthy minerals, show similar changes, a large number of which have been described in a most interesting memoir on the subject, by M. Haidinger.*

Crystals of blue carbonate and red oxide of copper are found changed into green carbonate, and the carbonate is again substituted for the oxide of this metal, the oxide for the sulphuret; sulphuret of lead is substituted for phosphate, and the carbonate for the oxide, the original form in these cases not being changed. These changes are often but partially advanced, being confined to the surfaces of the crystals, while the central portions retain the character of the original species, as has been observed among the crystals of phosphate of lead which are passing into the sulphuret.

Several non-metallic minerals also present the pseudomorphs of other species. The most common of these are the quartz imitations of carbonate of lime and fluor spar; those of serpentine, steatite, prehnite and carbonate of barytes being less common. It is probable that many substances have been called pseudomorphous which are not so; and the uncertainty which attends the recognition of those which are truly so, arises from the absence of any half-way stage in the formation of these crystals, or in the passing away of those whose places they are to occupy. Mr. Brooke (*Art. Mineralogy in the Encyclopedia Metropolitana*) has, however, recorded a single instance, in which there was a mould in preparation for a pseudomorphous crystal, from which a part only of the model, a cube of fluate of lime, had been removed, leaving in the cavity only a small loose nodule with an irregular and smooth surface, like that of partially dissolved salts. We have also observed precisely the same appearance in the beautifully smooth and regular cavities once occupied by crystals of apophyllite, at a single locality, in the porous amygdaloid of Nova Scotia. Sometimes nothing more remains of the crystal than a little powder situated in one corner of a cavity, now and then accompanied by the deposition of a few silky fibres of mesotype. Carbonate of lime has been subsequently infiltrated into many of these cavities, but in none of them has it taken the complete pseudomorphous character, having only deposited over their interior surfaces small stellæ of the dogtooth spar variety.[*]

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* On the Parasitic Formation of Mineral Species, depending upon Gradual Changes which take place in the Interior of Minerals, while their External Form remains the same. See Transactions of the Royal Society of Edinburgh, vol. xi., p. 73; or Brewster's Edin. Jour. of Science, vols. ix. and x. [AM. ED.]

Remarkable instances of pseudomorphism have been noticed in Cornwall by De la Beche. Carbonate of iron had covered cubical crystals of fluor spar which had been formed in bisulphuret of copper, and had disappeared, leaving cubical cavities produced by the crust of carbonate of iron. In these cavities quartz and bisulphuret of copper had crystallized. Here we have a curious series of events: first, the crystallization of the cubes of fluor spar; second, carbonate of iron incrusting them; third, their disappearance, leaving the carbonate of iron; and fourth, the cubical moulds which remain have been filled up by quartz and bisulphuret of copper. Many of the cavities were but partially filled.[†]

Pseudomorphs may be generally distinguished from true crystals by the want of regular internal structure, or susceptibility to cleavage, and by their imperfect exterior finish; but there are cases in which this distinction is determined with difficulty, where the substance possesses all the characters of true crystals: for example, the cubes of quartz found at Rochette were so perfect as to be mistaken by Haüy for the primary rhomboids of this mineral. It is not improbable that some of the supposed pseudomorphous crystals may prove to be the true forms of the mineral, and thus be classed among dimorphous bodies. Such, according to Dr. Tamnau, is the character of the serpentine, last named in the following table.

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[*] We should probably have had regular pseudomorphs, if any other forms of calcareous spar than those of the scalene triangular-planed dodecahedrons, had occurred at the locality. We know that certain forms of the same substance are peculiar to certain districts of country, and even localities of the same district; and hence, perhaps, we are furnished with the explanation of the phenomenon here alluded to. The partiality, if we may so term it, which the forms of crystals thus display in reference to locality, offers one of the most singular facts in the science of Mineralogy. [AM. ED.]

[†] Report on the Geology of Cornwall, &c., p. 391.

Table exhibiting the principal pseudomorphous minerals mentioned by Prof. Johnston, with the addition of several others, American and foreign:

Name.	*Form.*	*Replacing.*	*Localities and Authorities.*
Quartz	Cubes and octahedrons	Fluor Spar	Cornwall, Devonshire, &c.
Sulphuret of Copper	Cubes	Do.	Do. (*De la Beche.*)
———	Rhombs. and prisms	Calc Spar	Fontainbleau, Haytor.
Quartz (Haytorite)	Ob. ? rhombic prism	Sphene, Datholite ?	Haytor, Devonshire.
———	Cubo-octahedrons	Galena	Rochette, (*Dumont.*)
———	Right rhombic prisms	Sulphate of Baryta	Do. Do.
———	Oblique rh. prisms	Gypsum (lenticular)	Mont Martre.
Oxide of Tin	prisms	Felspar and Quartz	Cornwall.
Oxide of Antimony	Right rhombic prism	Sulphuret of Antimony	Saxony, (*Kobell.*)
Peroxide of Iron	Octahedrons	Magnetic Iron	Do. Do.
Serpentine	Regular Octahedrons	Spinel	Warwick, N. Y. (*Nuttall.*)
Hydrated Peroxide of Iron	Cubes and do	Iron Pyrites	Do. Do.
Do	Right rhombic prisms	Carbonate of Iron	Styria, Carinthia.
Pyrolusite	Right rhombic prism	Manganite	Saxony.
Sulphuret of Lead	Hexagonal Prisms	Phosphate of Lead	Cornwall. (*Fox.*)
Tungstate of Iron	Regular Octahedron	Tungstate of Lime	Monroe, T'mbull, Ct. (*Shepard.*)
Galena (Blue Lead)	Hexagonal prism	Chloro Phospate	Cornwall, Brittany.
Mixture of Carbonate and Phosphate	Regular Octahedrons	Galena	Do.
Copper Pyrites	Regular octahedrons	Lenticular Carbonate and Specular Iron	Cornwall.
Green Car. of Copper	Oblique rhombic prism	Blue Carbonate	Chessy, France.
Steatite	Hexahedral prisms	Hornblende	Warwick, N. Y. (*Beck.*)
Malachite	Octa. and rh. dodeca.	Red Oxide of Copper	Do.
Hornstone	Octahedrons	Octa. Fluor Spar	Cornwall, (*Fox.*)
Blue Carb. of Copper	Do.	Red Oxide of Copper	Chessy.
Gypsum		Anhydrite	Pesey.
Quartz	Cube	Fluor Spar	W'th'pt'n, Ms. (*Hitchcock.*)
Sulphate of Baryta	Rt. and ob. rh. prisms	Carbonate and Baryto-Calcite	Hexham, Alston.
Wolfram	Square prisms	Tungstate of Lime	Cornwall, Saxony.
Prehnite	Icositetrahedrons	Analcime	Dumbarton, (*Allan.*)
Hornstone	Rhomboids, &c.	Calc Spar	Schneeberg, Saxony.
Steatite	Do	Do. Quartz, Pearl Spar	Goepfersgrün Bayreuth.
Serpentine	Right rhombic prisms	Olivine	Snarum, Norway.

Isomorphism.

It was for a long time supposed that minerals which consisted of the same chemical elements, combined in the same proportions, would always exhibit the same crystalline forms. This was considered by Haüy as an established law. But it has been shown by Mitscherlich, that some of these elements may be entirely absent, or be replaced by the same number of atoms of other elements, without producing any change in the form of the crystal. The law which he endeavors to establish is thus stated: — "The same number of atoms combined in the same way produces the same crystalline form, and the same crystalline form is independent of the chemical nature of the atoms, and is determined only by their number and relative position." To the bodies which are thus capable of replacing each other, he has given the name of *isomorphous*, distinguishing the character of form by the name of *isomorphism*, from ἴσος, equal, and μορφὴ, shape. By some writers, those elements which take the place of others, have been called *vicarious* — an expression which gives a perfect idea of their relations to each other. As simply stated, the most important mineralogical bearing of this discovery is this: that however important crystalline form may be regarded by some, it is no indication of chemical identity in the character of species, and will not suffice to distinguish them from each other. As the hardness, specific gravity, comportment before the blowpipe, &c., of a mineral are also dependent on the nature of the substances of which it consists, it is obvious that specimens of the same species, from different localities, may appear under characters very considerably modified. Examples of this kind are well known among the garnets, and the minerals now included under the species pyroxene and amphibole. Among these, there has been a remarkable latitude given to the isomorphic influence. In the former, consisting essentially of silicate of alumina and lime, the alumina is sometimes almost entirely replaced by an equivalent quantity of peroxide of iron, while the lime is exchanged for protoxide of iron, or for magnesia, the crystalline form remaining unaltered. The same substitutions are also found among the zeolites, and, again, among several of the metallic ores. It has been supposed to be a necessary inference, that, in all cases of isomorphous replacement, the atoms of the acids, bases, and elementary substances, possess each the same ultimate form, and may therefore be substituted for each other without altering the form of the crystalline compound into which they enter as constituent parts. This inference seems confirmed by the more recent analytical researches of some of the ablest chemists, as Rose, Bonsdorf, Abich, and others, though it is still not admitted by all to its fullest extent. Another very important conclusion, to which chemistry leads us, is, that there is no limit to the proportions in which these bodies may be exchanged for each other in forming isomorphous mineral species, as well as various artificial salts.

The following list comprises the isomorphous bodies which play the most important part in Mineralogy, arranged in their several groups, and to which we shall have occasion to refer when describing the species:[*]

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[*] For a more extended list of isomorphous bodies, see Second Report of the British Association for the Advancement of Science, second edition; p. 118, Art. by Prof. Miller; p. 425, Art. by Prof. Johnston.

1.

Lime.
Protoxide of Manganese.
Peroxide of Copper.
Protoxide of Nickel.
Protoxide of Lead, *in Plumbo-calcite.*
Magnesia.
Oxide of Zinc.
Protoxide of Iron.
Protoxide of Cobalt.
Oxide of Cadmium.

2

Potash, Soda.
Ammonia.

3

Titanic Acid.
Peroxide of Tin.

4

Barytes, Lime.
Strontian.
Protoxide of Lead.

5

Arsenic.
Phosphorus.
Antimony.

6

Arsenic Acid.
Phosphoric Acid.
Antimonic Acid.

7

Chlorine.
Bromine.
Iodine.
Fluorine.

8

Sulphur.
Selenium.
Chromium.
Manganese.

9

Sulphuric Acid.
Selenic Acid.
Chromic Acid.
Manganic Acid.

10

Alumina.
Glucina.
Peroxide of Iron.
Deutoxide of Manganese.
Protoxide of Chromium.
Titaniate of Protoxide of Iron.

11

Sodium.
Gold.
Silver.*

Dimorphism.

The peculiarity which some substances, of the same definite chemical composition, possess of crystallizing under forms incompatible with each other, or belonging to different systems, was at first supposed to interfere with the general law of isomorphism established by Mitscherlich, especially when coupled with another fact, that the corresponding angles of crystals of the same substance, were found to fluctuate in one or two instances nearly a degree in their measurements. But it has been shown by Mitscherlich and others, that these may all be explained without doing violence to the doctrine he has promulgated.† Substances which thus assume two forms, may be simple or compound, as carbon and sulphur, or carbonate of lime and bisulphuret of iron; they are said to be dimorphous, from δὶς, twice, and μορφὴ, shape. The most common is carbonate of lime, which, when seen in common Iceland spar, is in the form of an obtuse rhomboid, and, when seen in arragonite, is in that of a right rhombic prism. One form of bisulphuret of iron, or common iron pyrites, is a cube, while another, that of white iron pyrites, is a right rhombic prism. There are several other minerals, as well as artificial saline compounds, which present analogous phenomena. Thus, idocrase and one of the varieties of garnet have the same constituents united in the same atomic proportion, viz: one atom of silicate of alumina and one atom of silicate of lime; yet the former crystallizes in right square prisms, and the latter in rhombic dodecahedrons. Zoisite and meionite also agree in chemical composition, each consisting of two atoms silicate of alumina and one atom silicate of lime; but one has for its primary form an oblique rhombic prism, and the other a right square prism. Among the artificial salts, biphosphate of soda and sulphate of nickel may be named as assuming each two forms. It is to be observed that these changes in crystalline form are usually accompanied by a remarkable change in all the other physical properties of the substance, such as hardness, specific gravity, optical characters, &c. as is the case with the minerals above referred to. But this is most strikingly shown in carbon, which, in the form of the diamond, (regular octahedron) is the hardest known substance, and in the form of graphite or plumbago (regular six-sided prism) is one of the softest. The cause of this singular property is by no means well understood; but as indicated by the two forms assumed by sulphur, it would seem to depend much on temperature, and the time allowed for crystallization to take place; for Mitscherlich obtained by artificial means, having regard to these two circumstances, crystals in the form of those occurring in nature, and of another form incompatible with them. Ingenious theoretical explanations have been given, and the student is referred to the article already named, by Prof. Johnston. This gentleman has added two new compounds to the list of dimorphous bodies, viz: carbonate of lead and chromate of lead; the former in the mineral called plumbo-calcite, occurs in rhomboids, and in white lead ore in the form of right rhombic prisms: the latter occurs native in oblique rhombic and right square prisms. As it thus replaces carbonate of lime in plumbo-calcite, but without altering its form, carbonate of lead possesses the double character of Isomorphism and Dimorphism, and has hence led to the term *Isodimorphism*. Mr. Brooke has added another — sulphato-tri-carbonate of lead — which, like carbonate of lead, presents the two distinct forms of a rhomboid and a right rhombic prism.

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* This group will probably be found to include several other electro-positive metals.

† See article by Prof. Johnston, on Dimorphous Bodies, Seventh Report of the British Association, p. 165; Graham's Elements of Chemistry, p. 138; Kane's do, p. 365.

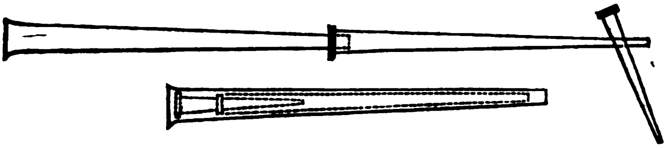
The number of dimorphous mineral bodies now amounts to about twenty. It is probable that other bodies will be discovered, which will prove to be Trimorphous, and even Polymorphous; that is, possess the same composition, but assume three or more incompatible forms. Facts seem already to lead to such a result. The subject is one of very great interest in mineralogy, and will undoubtedly continue to be investigated by those who have already added so much to our knowledge respecting it. No branch of the science is more deserving of the student's attention. As the former editions of this work contained no reference to this, nor to the subjects presented under the two preceding heads, (an omission scarcely to have been expected so late as 1837) the American editor has endeavored to state the most important facts in relation to them, though their omission was not observed by him in season to be supplied in an earlier part of this introduction.

CHEMICAL CHARACTERS.

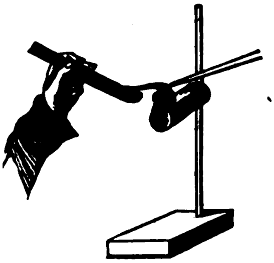
Although the chemical characters of a mineral are most fully and completely understood by its analysis, there are other means of arriving at some knowledge of its component principles; and, therefore, although the methods about to be described do not make us well acquainted with all that is to be known, they serve now and then to detect an important ingredient, and therefore add, by very simple processes, to the distinctive characters: the means are chemical, inasmuch as they produce a change, or partial decomposition.

Action of the Blowpipe.

To acquire the use of this instrument is at first somewhat difficult, but it is indispensable in the qualitative examination of minerals, and the student should persist in his trials with it, until he becomes familiar with its operations. Its effect depends on the power of producing a constant and pretty uniform stream of air, and as this current is not supplied at once from the lungs, but is forced from the mouth by means of the cheeks, the difficulty consists in inspiring and expiring through the nose, while at the same time a constant stream is kept up through the blowpipe. The mouth being filled, the communication between it and the lungs is to be closed by a peculiar action of the tongue, which is to be drawn back against the orifice, while the lungs are replenished through the nose; as the mouth becomes empty it is again to be filled from the lungs, and the communication closed as before, while the lungs are filling through the nostrils. The best mode of attaining the use of the blowpipe is, perhaps, to sit down to it with no other object at first than that of producing from the flame of a common candle a steady stream of flame, directed towards one point; taking care that the wick be of a moderate length, and the top of it bent in the direction of the blast. The best blowpipes are formed of silver: those made of brass are apt to get out of order, and glass does not stand the necessary heat. Several have been introduced, but the small pocket blowpipe, in three parts, contrived by Wollaston, will be found the most convenient for use. Those with bulbs in the middle, are awkward instruments, and are now but seldom used. Voigt's has an advantage from the circumstance that its beak may be turned round, so as to give any degree of obliquity to the flame. Griffin's, made of japanned tin, is a very good instrument, and the cheapest that has been contrived. The annexed figures show Wollaston's blowpipe, with the three parts connected and ready for use, and with the two smaller parts inserted in the mouthpiece, for carrying in the pocket in the most portable form possible.



The form of lamp recommended by Berzelius is that of which the figure is here given. It consists of a tin plate cylinder, one inch wide and four inches long. The wick-holder is three quarters of an inch across, intended for a flat wick. A screw cap is made to fit over this opening, to prevent the



escape of oil in travelling; and to the opposite end of the cylinder a small ring is attached, which slides up and down the rod, affixed by a screw to a retort stand-bottom.

If fusion be not in all cases produced by the use of the blowpipe, we have at least the advantage of seeing the impression made by very powerful heat; of noting the appearances and consequences which gradually take place, and which often are very characteristic.

It will be observed that there are two cones of flame projected from the pipe; the outer yellow, the inner blue — more properly dssignated as the *oxidating* and *reducing* flames of the blowpipe. The heat of the outer cone is less than that of the inner, and the most intense heat of the blue flame is near its point.

One is called the *oxidating* flame because at that point substances are rapidly *burned* or *oxidized*, and the other the *reducing* flame because in consequence of the excess of combustible matter at this point, the oxide of a metal, if a metal be employed, is made to part with its oxygen, or in other words is *reduced* to the metallic state. A metal may thus be oxidized and deoxidized as it is alternately exposed to the action of the two flames. The reducing flame is often called the *deoxidating* flame. These effects are well shown on oxide of copper, which, if it be exposed to the reducing flame, loses its oxygen and is converted into metallic copper; whilst, if the metallic copper be heated at the point of the outer cone, it is again oxidated by the oxygen of the atmosphere.

The substance to be acted on ought not to exceed the size of a grain of pepper; for if too large, a part of it will be without the focus of the heat, to which every part ought to be subjected alike. In most cases it will be advantageous to expose the mineral at first to the heat only of the outer flame.

Various methods, depending on the nature of the mineral, must be employed for supporting the fragment before the flame. Very small forceps will be sufficient, when the mineral has but little fusibility. For substances easily fusible, a small platina or silver spoon may be employed. It is important that these metallic supports should be very small, that they may not absorb too much heat. In using borax, a small platinum wire bent up at the end, for holding the substance to be examined, is usually employed. When metallic oxides are to be reduced, a piece of compact charcoal forms the best support. A small cavity is made in the charcoal, in which even minerals in a state of powder may be conveniently examined, especially if the cavity be partly covered by another piece of charcoal.

Minerals, while exposed to the action of the blowpipe, exhibit very different appearances, which, being directly before the eye, are easily observed, and should be minutely described. Sometimes their color is changed, or entirely disappears. Some minerals decrepitate, others divide or exfoliate, when exposed to the flame. Some indurate and contract their bulk; others effervesce, or, rising in little blisters, melt with intumescence.

On some minerals the blowpipe produces no effect whatever; others are partially fused; and others again melt with facility. The results of fusion may depend in some degree on the ntensity or continuance of heat, as well as on the nature of he substance. Some minerals by the action of the blowpipe are merely softened, and alter their shape; or, if in loose grains, they become agglutinated. Others are converted into a kind of porcelain, in which only a few points are vitrified. Some melt into a *slag*, which is a compact substance, containng metallic matter; others yield a tumefied mass, or are reduced into a *scoria*, which is light and porous; and others give an *enamel*, which has a vitreous aspect, but is not transparent; sometimes the enamel is only superficial.

Many minerals, when melted, yield a globule of perfect *glass*, which, in different substances, has various colors, and possesses different degrees of transparency. Both enamels and glasses are sometimes porous or vesicular.

These and all similar changes must be carefully noted, even he water and odor evolved during the experiment, the color which some minerals communicate to the flame, their phosphorescence, and every other phenomenon which may lead to he detection of elements whose presence was not anticipated, or perhaps even suspected.

Color of flame is a character of much importance. Those minerals which communicate a yellow or greenish-yellow tinge, contain soda; those giving a purple or crimson, contain lithia; those giving a yellowish-green or apple-green, contain barytes; while red is produced by the presence of strontian, and faint red or violet by that of potash. To observe these colors, it is necessary to produce a small and very clear blue flame, because a large jagged yellow flame overpowers or very much obscures them.

The presence of water is determined by taking a small crystal, or a compact piece of the mineral, of the size of half a pea, and, heating it before the blowpipe, or over a spirit lamp, in a small glass tube closed at one end, or in a narrow glass tube, one fourth of an inch wide, open at both ends, and held in the flame horizontally. In the latter case the water gathers in drops in the cold part of the tube, on both sides of the assay.

After having observed the alteration which the substance undergoes by the mere action of heat, it will be necessary to examine what farther change takes place when it is melted with various fluxes, and how far it is capable of reduction to the metallic state. Of these fluxes, or *re-agents*, as they are termed, the most invaluable for their respective purposes are the three proposed (we may truly say) in the infancy of the science by Cronstedt. These are,

1. The *Carbonate of Soda*, which is used for ascertaining by its means whether bodies be fusible or not, and for assisting the reduction of metallic oxides.

2. *Borax*, which is employed in effecting the fusion of a great number of substances.

3. *Salt of Phosphorous*, or microcosmic salt, a compound of phosphoric acid, soda, and ammonia, which, as it exhibits the action of acids on the assays, is particularly applicable to the examination of metallic oxides.

There are of course a variety of other uses to which each of these may be rendered subservient, and of which the skilful operator with the blowpipe will soon learn to avail himself; but as in some cases effects are required to be produced, which do not come within the reach of any of them, the test-box should also contain compartments for the following substances:

4. *Oxide of Copper*, to detect the presence of muriatic acid.

5. *Iron*, in the state of very thin wire, for ascertaining the presence of phosphorus.

6. *Tin*, in the form of foil, for promoting reduction in the fused vitreous compounds.

7. and 8. *Gypsum* and *Fluor Spar*, which, when well dried, are used mutually to detect each other.

9. *Bisulphate of Potash* and *Fluor*, mixed in the proportion of four and a half of the former to one of the latter, for ascertaining the presence of boracic acid.

10. Another very useful re-agent is a solution of the *Nitrate of Cobalt* in water, which, when concentrated, is employed to ascertain the presence of alumina, magnesia, and oxide of zinc, affording with the first a fine azure blue, with the second a pale rose color, and with the last a bright green color. These effects are produced by simply igniting the substances.

It is unnecessary, in a treatise like the present, to enter more at length on the subject of the blowpipe.[*] Suffice it to say, that the above re-agents are of the highest importance in the examination of metallic minerals. The ores of the difficultly reducible metals, such as manganese, cobalt, chrome, and titanium, are characterized by the colors which their oxides give to glass. In all these cases, therefore, glassy fluxes must be largely employed, both to dissolve the earthy matter with which the oxides are generally combined, and to furnish a body with little or no color of its own, which may receive and sufficiently dilute the inherent color of the oxide. When the color thus produced is so intense as to appear opake, it is requisite to flatten the glass, before it becomes solid, between a pair of forceps, or to draw it out into a thread at the instant it begins to cool.

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[*] The Compound Blowpipe, or Oxy-hydrogen Blowpipe, is not usually employed in the pyrognostic examination of minerals, as the calorific effect is too sudden and two powerful to admit of careful and progressive observations; but when it is desirable to melt a very refractory substance, the student may very properly resort to it. It was by means of this instrument, first invented by Dr. Hare, that Prof. Silliman was enabled to subject

A description of the comportment of each species, when exposed to the action of the blowpipe, is given in the body of the work, under their respective heads; and for further instruction, both as to the mode of performing experiments, the phenomena presented, and the results afforded by them, the reader is referred to the excellent work of Berzelius *On the Use of the Blowpipe in Chemical Analysis*, as translated by Mr. Children, or he may consult a small treatise by Griffin, on *Chemical Manipulation and Analysis by the Blowpipe.*

Scale of the Fusibility of Minerals.

It has long been desirable that we should have some general standards of comparison in the case of the fusibility of minerals, in order to assist in their easy recognition before the blowpipe. We are indebted to a late Treatise by Von Kobell * for a scale well drawn up, consisting of the following minerals, whose degrees of fusibility are in a decreasing order; the fusibility being expressed by one of the six figures, and a decimal fraction which marks how much the mineral under examination seems more difficult of fusion than the one opposite the figure, without equalling the next succeeding one on the scale. Thus, he expresses the fusibility of Apatite by 4·5, meaning that it is more difficult to fuse than Strahlstein, but less difficult than Adularia.

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to fusion substances which had been considered as fixed and infusible: such, for example, as silex, barytes, lime, magnesia, glucina, &c. These results are among the most brilliant achievements which have been recorded in the history of science for the last half century, and, in speaking of them, it is only just to add, that similar results were *afterwards* obtained by the late Dr. Clarke, of Cambridge University, England, and, as it is said, without any knowledge of what Prof. Silliman had done. [AM. ED.]

* Instructions for the Discrimination of Minerals by Simple Chemical Experiments, by Franz Von Kobell, Professor of Mineralogy in the University of Munich. The work has been translated, and published as one of the numbers of Griffin's Scientific Miscellany. Glasgow, 1841. [AM. ED.]

SCALE.

1. *Sulphuret of Antimony.*
2. *Natrolite.* (Mesotype.)
3. *Almandine.* (Precious Garnet.)
4. *Strahlstein.* (Hornblende.)
5. *Adularia.* (Moonstone, or Purest Felspar.)
6. *Diallage.* (Bronzite.)

All minerals which are distinctly fusible, fall within the first five degrees of this scale. Those which range between five and six, may be considered infusible, either when the pieces submitted to trial are not sufficiently slender, or when the operator is not a complete master of the blowpipe. Von Kobell observes (page ix) that one great advantage of the scale of fusibility is, that it facilitates the highly useful practice of *comparative experiment.* Two persons operating on the same mineral may sometimes differ as to its degree of fusibility; but when a person tries the fusibility of an unknown mineral against another whose fusibility is well ascertained, he has the advantage of a fixed point of comparison, which acts as a check upon erroneous experiments, that might otherwise lead to false conclusions. The minerals selected for this scale belong to those which can be procured without much difficulty. The analyst should be provided with a quantity of each, split into pieces of different sizes and shapes, from which to select such as closely agree in form with the pieces of the unknown minerals that are to be submitted to comparative experiment. This preliminary comparison of the form of two essays that are to be tried by comparative fusion, is the more necessary, since, at the best, the determination of the degrees of fusibility of a mineral, can only be considered as approximate exactness.

The pyrognostic characters of many of the species described in this volume, will be given according to the determination of Von Kobell. The letters B B signify before the blowpipe. Examples: Zoisite; B B it swells and froths, fusing = 3 to 3·5. Labradorite; B B fuses quietly = 3, giving a pretty dense clear glass. Tungstate of Iron; B B fuses = 3, to a grey, often crystalline, bead. It should be observed that when the characters as given by Von Kobell are different from those which have been recorded by Phillips, and taken from Berzelius, it has not been thought best to make any change other than in the *forms* of statement. Such differences do exist, and they are probably owing to the isomorphous or accidental bodies which the same mineral from different localities is known to contain, or perhaps sometimes to the different compactness or crystalline arrangement among the particles of the mineral.

Cupellation.

Cupellation is an operation which it is often convenient to resort to in separating metals which have a weak attraction for oxygen, as gold and silver, from those which readily pass into the condition of oxides. Thus, the silver which is always contained in galena, may be separated by continued exposure of the assay to the action of the blowpipe until the sulphur and lead have been driven off. The silver will remain in an extremely brilliant globule on the cupel. This cupel should be about one third of an inch in diameter, and is usually made of bone ashes, though pipe clay will answer the purpose. It is placed in a cavity made in a piece of charcoal, and the assay deposited in the small hollow upon its upper surface, the heat being applied gradually at first. In this way silver may be detected in the ordinary pig lead of commerce. The advantage of the cupel over a simple charcoal support is, that the assay is likely to become imbedded in the latter, so that the result is not so readily observed. On the cupel successive fragments of the ore may be subjected to the operation, and the resulting silver obtained in a globule of considerable size.[*]

Action of Acids.

Although complete analysis be not the object in subjecting minerals to the action of acids, yet we may thereby obtain characteristic information in regard to many species, especially the acidiferous, and some of the alkalino-earthy minerals.

In this process it will often suffice that a small fragment of the mineral, or a portion of it reduced to powder, should be placed in a concave receiver, a watch-glass, for instance, and that it be covered with diluted acid; for this purpose the muriatic is commonly used, but the nitric or sulphuric is sometimes employed. When effervescence ensues, it is important to notice the rapidity and degree of effervescence; in some minerals it is great and rapid, in others slow, and not very apparent: sometimes the solution is complete; sometimes a residue is left, and occasionally, as in some of the alkalino-earthy substances, the mineral becomes gelatinous. In most cases the process is carried on at the common temperature of the air; in others, by the application of a gentle heat.

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[*] As a substitute for the usual cupels of clay, or bone ashes, Prof. Mather (Am. Jour. of Sci. vol. xxxv, p. 381) recommends the use of thin slips of mica, on which the substance to be examined is treated in the same manner by oxidating the less permanent metals with which the silver or gold may be combined. The process is not quite as expeditious as the other, but it is as effective; and mica being always at hand, it may be often most convenient to resort to it. [Am. Ed.]

Hence it will be concluded that, in more than a few instances, the consequences of the action of acids form an important feature among the characters of minerals.

Elementary Substances.

It forms no part of our present object to describe the manner in which the chemist pursues his researches.* We look only to the results; to the information which is to be derived from the labors of the chemist in regard to the number and nature of all the chemical elements of minerals which have hitherto been analysed.

Minerals have been considered as either simple or compound. Strictly speaking, very few minerals are found in a simple form; for if, by that expression, be understood the *ultimate elements* into which a body has been resolved, only a small number of the native metals will fall within that definition. The true chemical elements which constitute, by their various proportions and modes of combination, the immense variety of mineral, and all other bodies belonging to our globe, so far as our present knowledge of them extends, amount to *fifty-four*, of which *forty-two* are metals. They are the following:

NON-METALLIC.

Oxygen. Hydrogen. Nitrogen.	Gazolites of Berzelius.	Chlorine. Iodine. Bromine. Fluorine.	Halogens of Berzelius.	Sulphur. Phosphorus. Carbon. Boron.	Metalloids of Berzelius.
	Selenium.			Silicium.	

METALLIC.

ORDER 1.—*Bases of the Alkalies and Earths.*

Potassium. Sodium. Lithium.	Bases of Alkalies.	Strontium.	Glucinium.
		Calcium.	Yttrium.
		Magnesium.	Thorium.
Barium.		Aluminum.	Zirconium.

ORDER 2.—*Metals which decompose Water, and retain Oxygen, at a red heat.*

Manganese.
Zinc.
Iron.
Tin.
Cadmium.
Cobalt.
Nickel.

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* On this subject reference should be had to the Treatise on Analytic Chemistry, by H. Rose; to Part Third of Thomson's Outlines of Mineralogy, Geology, &c.; "On the Method of Analyzing Minerals;" and also to a very recent and valuable Treatise on "Chemical Analysis, Inorganic and Organic," by Edward Andrew Parnell. London, 1842. [AM. ED.]

ORDER 3. — *Metals which do not decompose Water at any temperature, and whose Oxides are not reducible by heat.*

Arsenic.
Chromium.
Vanadium.
Molybdenum.
Tungsten.
Columbium.
Antimony.
Uranium.
Cerium.
Bismuth.
Titanium.
Tellurium.
Copper.
Lead.

ORDER 4. — *Metals whose Oxides are reducible by a red heat.*

Mercury.
Silver.
Gold.
Platinum.
Palladium.
Rhodium.
Osmium.
Iridium.[*]

It is not within the province of this work to give any thing more than a brief account of the history and general properties of the substances here enumerated. For further information of this kind, the student must consult the latest treatises on Chemistry. The object is rather to make known the atomic weights of their leading combinations with each other, as mineral constituents, and to give the symbols by which their composition will be expressed in the formulæ employed for this purpose in the subsequent part of this treatise. The atomic weights are given, both according to the oxygen and hydrogen scale; in all cases, however, in accordance with the doctrine originally advanced by Prout, and which Dr. Thomson endeavored to establish experimentally, that they are all *simple multiples of the atomic weight of hydrogen.*[†] For more convenient reference, a list of the various substances, with their equivalents and symbols, will be given after the conclusion of the following descriptions, containing also the weights as determined by Berzelius; and the student will be shown in what way the several members of it are to be employed in calculating the atomic constitution of minerals from analysis. Oxygen, instead of hydrogen, being taken as unity, the atomic weights of bodies are represented by a number which is eight times less than it would be were we to adopt the latter; it is therefore the simplest and most convenient for practical purposes, and has hence been preferred.

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[*] To the above list of elementary bodies must now be added the new metal Lanthanium, lately discovered by M. Mosander, though at present little is known of its combinations in the mineral kingdom, nor has its exact place been assigned among the metals. It has only been found associated with, or concealed in, Cerite, or Oxide of Cerium; whence its name from the Greek, to conceal. It forms two oxides, and seems closely allied to Yttrium and Zirconium. They are also combined with a third new element (Didymium) from which as yet they have not been entirely separated. [AM. ED.]

[†] More recent experiments, by several distinguished chemists, may now be adduced in favor of Dr. Prout's idea, as those by Dumas, Marchand, and Erdmann, instituted on water, carbon, and several of the gases and metals. It is remarked by Kane, "that the

I. — NON-METALLIC BODIES.

Oxygen has never yet been obtained in a state of complete insulation. Its most simple form is that of an elastic fluid or gas, resembling, in mechanical properties, the air of our atmosphere, and not condensible into a liquid by any known degree of cold. Oxygen gas was first obtained by Priestly, in 1774, and may be separated by heat from black oxide of manganese, chlorate of potassa, &c. Its specific gravity, that of air being 1 at mean temperature and pressure, is 1·1111; hence 100 cubic inches weigh 34.60 grains. Oxygen unites with some bodies slowly and imperceptibly; with others rapidly, and with the extrication of heat and light; and the resulting compounds are sometimes gaseous, sometimes fluid, at others solid. In the compounds thus generated new properties are apparent; some being *acid*, others *alkaline*, others, which are neither acid nor alkaline, being called *oxides*. Among the non-metallic bodies, hydrogen, carbon, and silicon, are those, in union with which oxygen is most abundantly diffused through the mineral kingdom, under the forms of water, carbonic acid, and silica. Of its combinations with metals, the most universal are those with calcium, aluminum, and iron. Oxygen gas constitutes about four fifths in volume of the air of our atmosphere, to which it imparts the property of being respirable, and supporting combustion. Its combining proportion, or equivalent number, that of hydrogen being taken as unity, is 8; its symbol O. But oxygen is now usually made the standard to which all atomic weights refer, and is expressed as either 1 or 100, hydrogen being either 0·125 or 12·5.

Chlorine, discovered by Scheele in 1774, is a gas of a yellowish-green color, not capable of being permanent over water, which absorbs twice its volume. Its specific gravity is 2·5, which gives 75·67 as the weight of 100 cubic inches. It is condensible by a pressure of four atmospheres, into a yellowish liquid; is not respirable, and, if breathed unmixed, produces suffocation. It unites with an equal volume of hydrogen gas, giving two volumes of *hydro-chloric* or muriatic acid, which acid is absorbed to a great extent by water. Chlorine combines also with most of the metals, with some exhibiting the appearance of a brilliant inflammation. In nature it exists most abundantly in common salt (chloride of sodium), which

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equivalent numbers of Berzelius must be looked upon as being, in a slight degree, still open to revision. Phillips has lately reöpened the discussion in England, and Dumas is inclined to consider the original views of Prout as being probably correct." Elements of Chemistry by Robert Kane, M. D., p. 333. (Dublin Edition, 1842.) [Am. Ed.]

contains it in the proportion of about 60 per cent. Its equivalent number is 4·5, oxygen being reckoned as unity, or 36 by the hydrogen scale; its symbol Chl.

Iodine was discovered in 1812, by M. Courtois of Paris. It may be ranked among mineral products, inasmuch as it exists in sea-water, and in the water of several natural springs. The process for obtaining it is too complicated to be described here; and it may be purchased ready prepared. It occurs in shining scales, having the lustre and color of steel, or rather of micaceous iron ore, the specific gravity of which is 4·948. It is crystallizable; and the crystals have, for their primitive form, a rhombic octahedron. At 225° Fahrenheit it fuses, and at 347° forms a rich violet-colored vapor, of specific gravity 8·7012; hence 100 cubic inches must weigh 269·84 grains. Iodine possesses an exclusive range of combination, and forms acids both with oxygen, hydrogen, and chlorine; but, compared with any of these elements, it is a very rare production of nature. Its equivalent, oxygen being unity, is 15·75, or 126 by the hydrogen scale. Its symbol is I.

Bromine, discovered by M. Balard of Montpellier in 1826, exists in sea-water in the state of bromide of sodium or bromide of magnesium, but in very minute quantity; and sparingly also in several mineral springs. At common temperatures it is liquid; dark red by reflected, hyacinth-red by transmitted light; its odor is strong and unpleasant, its taste acrid. At 116° Fahrenheit it boils; between 0 Fahrenheit and —4° it congeals. The density of its gas is 5·54. It acts powerfully on animal substances, and is extremely poisonous. It unites with all the simple bodies that have been enumerated, and with the metals, forming, with the latter a class of compounds called *bromides*. Its equivalent is 9·75 by the oxygen scale, or 78 by the hydrogen; its symbol Br.

Fluorine has never yet been obtained insulated. From analogy it is believed to constitute, with hydrogen, *hydro-fluoric acid*, which was first described by Gay-Lussac and Thenard in 1810. The estimated proportion is 1 by weight of hydrogen to 18· fluorine, which number therefore expresses its equivalent. The great repository of this element in nature is the mineral called *fluor spar*, from which hydro-fluoric acid is obtained by distillation with sulphuric acid in a leaden vessel. The acid is gaseous over mercury, but acts powerfully in glass vessels, which, to contain it, must be coated internally with bees' wax. The gas is copiously absorbed by water; and the liquid may be kept in leaden vessels well stopped, at temperatures under 60° Fahrenheit. A strong solution corrodes and destroys animal substances; and, when applied to the human skin, produces deep ulcerations. The gas unites with silica, and forms *fluo-silicic acid.* The equivalent of fluoric, or hydrofluoric acid, (oxygen being 1) is 2.375. Its symbol is Ḟl.

Nitrogen, or Azote, is not known to us separately in a solid or liquid form. The great repository of it is the atmosphere, of the whole volume of which it forms about four fifths. It was discovered by Professor Rutherford of Edinburgh, in 1772, and may be obtained by several processes, the object of most of which is to take away the oxygen gas from atmospheric air. It is a colorless gas, incapable of supporting respiration or combustion; tasteless, and free from smell; its specific gravity 0.972; sparingly absorbable by water; and in its gaseous state not disposed to enter readily into combinations. It is the base of nitric acid, an acid which enters into the composition of nitrate of potassa and nitrate of soda, both found in the mineral kingdom. The combining number of nitrogen is considered by some chemists to be 14·00, hydrogen being unity; or 1·75, oxygen being unity. Its symbol is N, that of nitric acid Ṅt.

Hydrogen, in its simplest form, is a gas. It is obtained by the action of iron or zinc on dilute sulphuric acid. It is permanent over water, destitute of color, and, when pure, of smell; combustible, and the lightest of all known bodies, its specific gravity being to air as 0.0687 to 1. With half its volume of oxygen gas it combines and forms water; with an equal volume of chlorine gas it forms *hydrochloric* acid; and it composes analogous acids with iodine, bromine, and fluorine. Its presence in the mineral kingdom is therefore very extensive, perhaps more so than that of any other element except oxygen. Its equivalent, or atomic weight, (oxygen being 1) is 0·125, or 8 times less than unity, making the atomic weight of water 1·125. But by many chemists hydrogen is expressed as unity, and oxygen 8, the equivalent for water thus being 9. Its symbol is H. The symbol for water is HO, or Aq.

Boron is an artificial product, obtained by the action of potassium on boracic acid, which acid is found in nature both separate and in union with soda. Boron is a dark olive-colored solid, possessing neither taste nor odor; about twice the weight of water; not fusible when intensely heated in a close vessel, but, when exposed at the temperature of 600° to the atmosphere, taking fire, burning, and being converted into boracic acid. Chemists differ in stating the atomic weight of boron; Dr. Thomson, from data furnished by himself and Davy, fixes it at 8, or the same as oxygen, according to which the atomic weight of boracic acid (1 eq. base, 2 eq. oxygen) is 24. Or oxygen being unity, the former is 1 and the latter 3. Symbols: boron B, boracic acid $\dot{B}$.

Carbon. In its ordinary form this substance is best represented by pure anthracite coal, or by charcoal obtained from the most solid kinds of wood. But in the diamond it exists in perfect purity. It is highly combustible, and has extensive powers of combination. When burned in oxygen gas, it does not, under circumstances favorable to such a result, alter the volume of the gas, but gives precisely an equal bulk of carbonic acid gas. This acid gas, if pure, has the specific gravity 1·5277; hence 100 cubic inches 47·262 grains, a specific weight which, in some subterraneous places, occasions it to occupy a situation nearest the ground. It is non-respirable, and is incapable of supporting combustion. Carbon is most extensively diffused through the mineral kingdom, especially, as will afterwards appear, in the compounds of carbonic acid with various bodies, and in the several varieties of coal. Its equivalent is 6; that of carbonic acid 22; or, by the oxygen scale, carbon, 0·75; carbonic acid (1 atom carbon + 2 atoms oxygen) = 2·75. Its symbol is C; that of carbonic acid $\dot{C}$.

Silicon, or Silicium, is also an artificial product, obtainable from the earth called *silex*, or *silica*, which enters into a very great number of mineral bodies, and in large proportions. It was discovered by Berzelius in 1824. At first it was considered to be a metal, but it has since been thought to bear a more striking analogy to boron, carbon, &c. It is of a dark nut-brown color, without any metallic lustre; incombustible in air or in oxygen gas, but oxidizable by circuitous methods, which convert it into *silica*, now more properly called *silicic acid*, which is the only known oxide of silicon, and constitutes a number of minerals, as quartz, calcedony, amethyst, opal, &c. It performs the part of an acid, uniting with several bases, forming *silicates*, among which the zeolite minerals may be mentioned. Silicon resembles boron very closely in some of its properties, and it has the same atomic weight with that body. Its equivalent, by the hydrogen scale, is 8; that of silica or silicic acid, 16. The equivalent for silica is thus 2 by the oxygen scale, and, in stating the composition of minerals, it will be denoted simply by the initial S.

Sulphur is an abundant product of the mineral kingdom, not only in a nearly pure state, but also in combination. As met with in commerce, it is chiefly the product of volcanos; and it is also obtained from *pyrites*, a compound of iron or copper, and sulphur. Its color is yellow; its specific gravity 1·99; it begins to fuse at 216° F., and becomes more and more fluid up to 280°. At 550° or 600° F., it is volatilized, and gives a vapor, the specific gravity of which is between 6·5 and 6·6. This vapor, when condensed, forms *flowers of sulphur;* and the flowers, when melted and cooled, become *roll* or *stick sulphur*. By slow cooling, sulphur takes a regular crystalline form. When heated to 300°, or a little more, in the open air, it takes fire and burns, with a blue flame of suffocating smell.

Sulphur unites with oxygen in various proportions; but its most important compound with that basis is sulphuric acid, in which, in combination with various substances, it is very common in the mineral kingdom. With hydrogen it forms sulphuretted hydrogen gas, a natural product; and with the metals it constitutes the important class of mineral compounds called *sulphurets*. Its equivalent number by the hydrogen scale is 16; that of the acid is 40. Reckoning oxygen as unity, the equivalent of the former is 2, of the latter 5. Symbols: sulphur, Sl; the acid, $\dot{\mathrm{S}}\mathrm{l}$.

Selenium, first made known by Berzelius in 1818, is rather a rare substance. It was first obtained from some varieties of Swedish iron pyrites, and has since been found combined with lead, cobalt, silver, mercury, and copper. Its chemical habitudes approach most nearly to those of sulphur, from which, however, it is readily distinguishable. It has, when in mass, a metallic lustre and the aspect of lead; and, when pulverized, exhibits a deep red color; its specific gravity is 4·3; at 212° F. it softens, and may be drawn into fine threads, which are red by transmitted light. It becomes fluid a little above 212°, and at 650° is converted into a deep yellow vapor. It unites with oxygen in three portions, forming oxide of selenium, selenious acid, and selenic acid; the latter, consisting of 1 equivalent base and 1 of oxygen, occur in combination with several metals. Its equivalent by the hydrogen scale is 40; by the oxygen scale, 5; that of selenic acid is 64 and 8. Symbols: selenium, Sel; selenic acid, $\dot{\mathrm{S}}\mathrm{el}$.

Phosphorus is an artificial solid, obtained most abundantly, by a circuitous process, from bones, but also derivable from the mineral kingdom. It is fusible at 108° F.; volatile at 550°. It is highly combustible, both in air, in oxygen gas, and in chlorine. According to the proportion of oxygen, it forms different acids; and one of these, the *phosphoric acid*, in union with lime, exists in the mineral kingdom. It unites also with hydrogen. Its equivalent by the hydrogen scale is 16; by the oxygen, 2; that of the acid, 36, 3·5. The symbol for phosphorus is Ph; that for the acid is $\dot{P}h$.

II. — METALS.

ORDER I.

Potassium was discovered by Sir H. Davy in 1807. It does not exist in nature as a metal, but is obtained by artificial methods, all of which have in view the decomposition of potash or potassa. It is soft and solid at common temperatures, and yields like wax to pressure; it begins to melt at 70°, and is quite fluid at 150° F. It rises into vapor when heated in a vessel from which atmospheric air is excluded. In color and lustre it resembles quicksilver; is quite opake; conducts heat and electricity, and has the specific gravity 0·865, or it is considerably lighter than water. It is highly oxidable, and even takes oxygen from water, on the surface of which it burns with a bright flame by a succession of explosions. Its equivalent is 5, which, uniting with one equivalent of oxygen, forms protoxide of potassium, or potash, a substance which enters into the composition of a large number of minerals. The symbol is K, the first letter of Kalium, by which name it has been distinguished by foreign chemists.

Sodium, in its external properties, resembles potassium; but it has greater specific gravity, viz: 0·972. It fuses at 200° F., and is not volatilized by a heat under redness. When united with oxygen in the proportion of 3 by weight to 1 oxygen, it constitutes *soda*, also an important ingredient of several mineral substances, such as the chloride and the carbonate, and in several of the varieties of zeolite. Its symbol is N, from Natrium, the name given to it by German chemists.

Lithium. The oxide of this metal, *lithia*, was discovered by M. Arfwedson in 1818, in the mineral called *petalite;* and it has since been extracted from spodumene, lepidolite, and some kinds of mica, and also from the waters of Carlsbad, by

Berzelius. From lithia, the metal is obtained by deoxidizing processes; but if placed in contact with air, it returns to the state of lithia too rapidly to admit its accurate examination. In its obvious properties, lithia approaches to potassa and soda, but has a greater neutralizing power, and its salts tinge the flame of the blowpipe of a red color. It attacks platinum when fused upon it, leaving a yellowish trace. The equivalent of lithium, as given by Thomson, is 0·75; Lithia, 1·75. The symbol is L.

Barium. Barytes, the source of barium, a metal which can only be got by chemical operations, was discovered by Scheele in 1774. Barium has a dark grey color, and a lustre resembling that of cast iron. It is much denser than water, and even than sulphuric acid. It attracts oxygen with avidity, and is reconverted into barytes, which is the protoxide, and the only oxide which concerns us as mineralogists; the equivalent of which is 9·5, that of barium being 8·5. The symbol for the metal is Ba.; that of barytes Br.

Barytes is pretty extensively diffused through the mineral kingdom, chiefly in combination with the carbonic and sulphuric acids, as witherite and heavy spar.

Strontium. The source of this metal, which does not exist as such in nature, is *strontian*. The carbonate of that earth was first accurately examined, and the peculiarities of its earthy base established, by Professor Hope of Edinburgh, in 1792. Little is known of the properties of strontium in its metallic form; but it is white, solid, harder than potassium or sodium, according to Prof. Hare; much heavier than water, and bears a close resemblance to boron. When exposed to air or water it absorbs oxygen and is converted into strontian, which consists of one atom metal, 5·5, and one atom oxygen, 1, = 6·5. The combining proportions are therefore 5·5, strontium; 6·5, strontian. The symbol of strontian, which alone concerns mineralogy, is Str. In nature, the carbonate and sulphate of strontia are not very uncommon productions.

Calcium, the metallic base of the well-known earth *lime*, has been obtained only in very small quantities, and its properties have not been accurately investigated.* It is of a whiter color than barium or strontium, and is rapidly converted back again into lime, or *protoxide of calcium*, composed of 1 atom oxygen, 1 atom base. This oxide forms a very large proportion of the crust of our globe, chiefly in the shape of carbonate of lime, which constitutes whole mountains and extensive strata; and also of sulphate of lime. Lime, it is well known, heats violently on the addition of water; is sparingly soluble in that fluid; has an alkaline re-agency, and enters into energetic combination with a great variety of bodies. It forms an essential ingredient in a large number of simple crystallized minerals. The symbol for lime is Cal; its equivalent 3·5.

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* Prof. Hare, of Philadelphia, by an improved process, has been able to obtain this, and the two preceding metals, in quantities sufficient to show with much more distinctness their characteristic properties. See Am. Jour. of Science, vol. xxxvii, p. 67. [Am. Ed.]

MAGNESIUM was discovered by Black, 1775. Its oxide, *magnesia*, is pretty extensively diffused as a constituent of mineral bodies. The chief natural compounds of magnesia are with sulphuric, muriatic, silicic, and carbonic acids; and with alumina and other earths. It forms an atomic combination with water, or a hydrate, which occurs in the native state. The equivalent of the metal is 1·5: that of its only oxide, magnesia, 2·5, of which the symbol is Mg.

ALUMINUM, discovered by Magraff, 1754, is the metallic base of *alumina*, or pure argillaceous earth or clay, than which, few substances are more extensively diffused throughout the mineral kingdom. Aluminum was first artificially obtained by Wöhler; it presents the appearance of a grey powder, very similar to that of platinum. It requires an intense heat for its fusion, and shows a feeble affinity for oxygen, so far as is indicated by direct combination. Alumina is viewed by Berzelius and others as a sesqui-oxide, consisting of two equivalents aluminum, and three of oxygen; but Dr. Thomson makes it to consist of one atom of each; its equivalent being 2·25. Its symbol is Al. In its purest crystallized form, alumina constitutes sapphire and ruby, two of the hardest gems. Like silex, though in but few instances, it acts the part of an acid in mineral combinations, and forms *aluminates*.

GLUCINIUM. Its source, *glucina*, was identified as a distinct earth by Vauquelin in the year 1798. At first it was found only in euclase, beryl, and emerald, and may still be considered a very rare product of nature. Its name was derived from a Greek word signifying sweet, a property observed in all its salts. Glucina itself is white, insipid, and insoluble in water. By some it is regarded as a sesqui-oxide; but by Thomson and Brande its equivalent is put down at 3·25, the metal being 2·25; or it consists of only one equivalent metal, and one of oxygen. Its symbol is G.

Yttrium is the base of the earth *yttria*, which was discovered by Professor Gadolin in 1794, in a mineral found at Ytterby in Sweden, since called gadolinite. Yttria bears a considerable resemblance in its properties to glucina. It is a protoxide, and exists in one or two other minerals besides gadolinite, which are mentioned in this volume. Its symbol is Y, its equivalent 5·5; yttrium 4·5.

Thorium. The earth *thorina* has only been obtained by Berzelius from a rare Swedish mineral now called *thorite*. The high specific gravity of this earth, 9·042, is its most remarkable characteristic. Its equivalent is not known, but is supposed to be about 68, hydrogen being unity, or 8·5, oxygen being unity. Its symbol is Th.

Zirconium is the base of the earth *zirconia*, which was discovered in 1789 by Klaproth in the jargon or zircon of Ceylon, in the hyacinth of France, and more recently by Dr. Muir, in Sillimanite of the United States. The nearest approximation to its equivalent is probably, according to Berzelius, between 30 and 33; that of zirconia, which is concerned in mineralogy, oxygen being unity, is stated at 3·75; its symbol, Zr.

ORDER II.

Manganese, discovered by Scheele in 1774, was first reduced to the metallic form by Gahn, (same year) from the black oxide of manganese, a substance first investigated by Scheele. As a metal, it possesses so powerful an affinity for oxygen that it never occurs native. It is of a grey color; has a granular texture; a specific gravity of about 8; is hard and brittle; and is very difficult of fusion. Its oxides are, 1*st*, the *protoxide*, which is the base of all the salts of manganese. This is of a light green color, is composed of 28 parts by weight of metal, and 8 of oxygen; and has so strong an attraction for a further proportion of that basis, as to take fire and burn when heated to about 600° F. in the open air. 2*d*, the *sesqui-oxide*, which may be obtained artificially, is also found in nature, combined only with water, and constituting prismatic crystals. It is the sesqui-oxide which remains after heating the next oxide to redness; it consists of two equivalents of manganese and three of oxygen. 3*d*, the *bin-oxide*, the well-known black ore (pyrolusite) used in preparing chlorine, consists of 28 manganese and 16 oxygen, or of one equivalent of metal and two equivalents of oxygen. Besides these well-characterized oxides, there are three others, two of which occur native, and may, perhaps, more properly be regarded as compounded of two of those already described; these are the mineral called *varvicite*, and the *red oxide*, or *oxidum manganeso-manganicum* of Arfwedson. The other possesses acid properties, and is called manganesic acid, composed, according to Dr. Thomson, of one equivalent of the sesqui-oxide, and one equivalent oxygen, or, which is the same thing, of one equivalent manganese, and two and a half equivalents oxygen. Stated by the oxygen scale, the equivalent of the metal is 3·5; that of the protoxide (one atom manganese, one atom oxygen) is 4·5; that of the sesqui-oxide (one atom metal to one and a half atom oxygen) is 5; that of the bin-oxide (one atom metal to two atoms oxygen) is 5·5. The symbol of the metal is Mn.; that of the protoxide, $\underline{M}n$; of the sesqui-oxide, $\underset{\cdot}{M}n$; of the bin-oxide, $\underset{\cdot}{M}\underset{\cdot}{n}$.

Zinc was first mentioned by Paracelsus, but its ores were known at a much earlier period. In commerce it is commonly known under the name of *spelter*, which is a very impure form of the substance, and is obtained from the native carbonate of zinc, called calamine, or from the sulphuret (blende) by distillation *per descensum*, it being a very volatile metal. It has a bluish white color, with a brilliant lustre; its specific gravity is about 7. At common temperatures it is tough and intractible under the hammer; but when heated to above 500° it becomes brittle, and fuses at 770°. In this state it combines rapidly with oxygen, producing greyish white flocculi, which were called by the ancients *pompholyx* and *philosopher's wool*—but are now known as flowers of zinc, or the white oxide of zinc. This is a protoxide, and the only known combination of oxygen and this metal, consisting of zinc 80·95, oxygen 19·04, or one equivalent of each. This oxide enters into the composition of several mineral species, as zinciferous spinel and franklinite. The equivalent of the metal is 4·25, that of its oxide 5·25. Its symbol is Z, that of the oxide $\underset{\cdot}{Z}$

Iron is a metal too well known to need description. Of all the metals, it is the one which is most abundant in the mineral kingdom. It is malleable and ductile; its specific gravity, which varies according to the processes it has undergone, is about 7·7; it powerfully attracts oxygen, and in oxygen gas even burns with brilliant corruscations. There are two distinctly characterized oxides of iron; the one, which is black, but affords green salts with acids, is constituted of twenty-eight parts of iron and eight of oxygen, and is called the *protoxide;*

the other, named *peroxide*, may be viewed as composed either of two equivalents $(28 \times 2) = 56$ of iron, and three equivalents of oxygen, or of one, and one and a half. The color of the peroxide is red, and it imparts that color to its saline combinations. Combined with water, it forms an important class of ores, the hydrated peroxides, or hematites. Besides these two oxides, there is a native black compound of iron and oxygen, composed of the protoxide and peroxide in atomic proportions, and called by Berzelius *oxydum ferroso-ferricum.* This is the common magnetic iron ore of mineralogists, described in this work under the title of pleisto-magnetic iron. There are also three other definite combinations of these two oxides. The magnetic ore is found in regular octahedral crystals, which not only affect the magnet, but are sometimes magnetic. Iron also enters very extensively into combinations with other simple and compound bodies. Its compounds with sulphur are, next to its oxides, the most important to the mineralogist. The *proto-sulphuret*, both artificially prepared and occurring native, consists of 28 iron and 16 sulphur; the *sesqui-sulphuret* is an artificial product, of 56 iron and 48 sulphur; and the *bi-sulphuret* (native iron pyrites) consists of 28 iron and 32 sulphur. Besides these, there are other sulphurets, formed by the union of the preceding ones in different proportions. With carbon, iron forms that useful mineral product *plumbago*, or *graphite*, which is also an artificial production. The symbol of iron is F; of the protoxide, $\underline{\mathrm{F}}$; for the peroxide, $\underset{\cdot}{\mathrm{F}}$ Oxygen being reckoned as unity, the combining proportion of iron is 3·5; of protoxide, (1 atom iron, 1 atom oxygen) = 4·5; of peroxide, 1 atom iron 1½ atom oxygen) = 5.

Tin, in the form of pure grain tin, is of a white color, resembling silver, and has a similar lustre. It is malleable and ductile, the latter in a less degree than some other metals. Its specific gravity is about 7·9; it fuses at 442° F.; and, when more strongly heated, takes fire and burns into *protoxide*, which consists of one equivalent (7·25) of metal, one of oxygen. This oxide is combustible, and, when touched by a red-hot body, burns in the air with *peroxide*, consisting of the same weight of metal and 2 atoms oxygen. The equivalent of the protoxide is therefore 8·25, of the peroxide 9·25. Besides these, an artificial compound may be formed of two equivalents of tin and three of oxygen, called the *sesqui-oxide*. Analogous to these are the three sulphurets, the *proto-sulphuret*, *bi-sulphuret*, and *sesqui-sulphuret*. The symbol of tin is Sta., from its Latin name Stannum; that of the peroxide is $\underset{\cdot}{\mathrm{S}}\mathrm{ta}$.

Cadmium was discovered by Stromeyer in 1817, in an oxide of zinc. It may be obtained from the sublimate which rises from calamine. Cadmium is both ductile and malleable; resembles tin in appearance and fusibility; is nearly as volatile as mercury, and its vapor, which is free from odor, condenses into shining drops. Its specific gravity is about 8·6. When heated in the open air it is readily oxidized. Its only oxide is of an orange-yellow, and consists of 5·6 cadmium and 8 oxygen, or one equivalent cadmium and one of oxygen. In the oxygen scale of proportions, 7 will represent the metal, and 8 the oxide. Its symbol is Cd. It does not exist as a distinct mineral species.

Cobalt, discovered by Brandt in 1733, is principally obtained from an ore of arsenic, and is found in small proportion in meteoric iron. It is a brittle metal, of a reddish-grey color, and feeble lustre; its specific gravity about 8·7; fusible at a heat rather below that at which iron melts; attractible by the magnet, and readily oxidable. It constitutes with oxygen two distinct oxides, the protoxide and the sesqui-oxide, the first composed of 1 atom cobalt and 1 atom oxygen, the last composed of 1 atom cobalt and 1½ atom oxygen. According to Gmelin, there is also a third oxide, which possesses acid properties, and is called by him *cobaltic acid.* This is the peroxide, or a compound of 1 atom metal, 2 atoms oxygen. The distinguishing character of this metal is, that in solution it forms the basis of the best sympathetic inks. Sulphur also unites with cobalt in three proportions. Its symbol is Cb.; its equivalent 30, hydrogen being unity, or 3·75 by the oxygen scale. Symbol for the native oxide, $\underset{\cdot}{\mathrm{C}}\mathrm{b}$

Nickel. This metal was discovered by Cronstedt in 1751. It has the specific gravity of about 8·5 to 9; is ductile and malleable, and is not only attracted by the magnet, but capable of being itself rendered magnetic. It is very infusible; is not altered by the air at common temperatures, but absorbs oxygen at a red heat. The solutions of this metal in acids have, for the most part, a beautiful green color. Nickel occurs in the metallic state with meteoric iron. But the nickel of commerce is obtained from the ore of cobalt. When pure, it is of a color resembling silver. It combines with two proportions of oxygen, forming the protoxide and sesqui-oxide. Its equivalent is the same as that of cobalt, above mentioned. Symbols: Nk for the metal; $\underset{\cdot}{\mathrm{N}}\mathrm{k}$ for the native oxide.

ORDER III.

Arsenic, in its metallic form, has a strong metallic lustre; is brittle, and reducible to powder; is volatilized, without fusing, at 365° F.; and, in close vessels, condenses into a brilliant solid. The specific gravity of metallic arsenic is 5·88. Its vapor is characterized by a strong odor, resembling that of garlic. Arsenic readily combines with oxygen, and forms two compounds. The first, known as common arsenic, or white oxide of arsenic, but now more properly termed *arsenious acid*, is of a white color, sparingly soluble in water, and intensely poisonous. It consists of 38 arsenic and 12 oxygen $= 50$. The second, *arsenic acid*, is the result of chemical operations, but is also found native in combination. It consists of 38 metal and 20 oxygen $= 58$. Or if oxygen be unity, the equivalent of the former will be 6·25, of the latter 7·25, the metal being 4·75. Of the *sulphurets* there are three, constituted of one equivalent of arsenic, with one, three, and five equivalents of sulphur respectively. Symbols: arsenic, As; arsenious acid, $\dot{\mathrm{A}}\mathrm{s}$; arsenic acid, $\overline{\mathrm{A}}\mathrm{s}$.

Chromium was discovered by Vauquelin in 1797, in a beautiful red mineral, then called chromate, more properly *dichromate*, of lead. Chromium is a brittle infusible metal, of specific gravity about 5, capable of uniting with oxygen, and of forming two distinct compounds. The green *sesqui-oxide* consists of 56 chromium (two equivalents) and 24 oxygen (three equivalents). The chromic acid of 28 (one equivalent) of metal, and 24 (three equivalents) of oxygen. But Dr. Thomson has given evidence to prove that the equivalent of chromium, by the hydrogen scale, should be 32, and this has been adopted by Henry and others. Thus, by the oxygen scale, the metal is 4, that of the green oxide 5, that of the acid 6·5. (*Inorganic Chemistry*, vol. ii., p. 331.) All the compounds of chromium are distinguished by their brilliant colors, whence is derived the name of the metal. Symbols: chromium, Ch; oxide of chromium, $\underset{\cdot}{\mathrm{C}}\mathrm{h}$; chromic acid, $\dot{\mathrm{C}}\mathrm{h}$.

Vanadium was discovered in 1830, by Sefström, and has since been found by Professor Johnston in *vanadiate of lead*. It is extracted by complicated processes, and is but indistinctly characterized as a metal. In color it resembles silver, or rather molybdenum; it is extremely brittle, and unites with oxygen, according to Berzelius, in three proportions, forming the protoxide, the deutoxide, and the peroxide, or vanadic acid, composed respectively of 1 atom of vanadium, and 1, 2, and 3 of oxygen. The equivalent of the metal is about 68·, or 85 of the oxygen scale. Its symbol is Vn; that of the acid, $\dot{\mathrm{Vn}}$.

Molybdenum, discovered by Scheele in 1778, is a white, brittle, and very infusible metal; its specific gravity about 8·6; it is easily oxidizable, and has three degrees of oxidation, one of which is acid. In the protoxide, peroxide, and molybdic acid, 48 molybdenum are respectively united with 8, 16, and 24 oxygen. It combines also in three proportions with sulphur; and the bisulphate, composed of 2 atoms sulphur and 1 atom molybdenum, is the common ore of the metal. Molybdic acid is represented by the equivalent 72, or by 9, according to the oxygen scale. It forms a native combination with lead. The equivalent of the metal, by the oxygen scale, is 6; symbol, Ml; that of the acid, $\dot{\mathrm{Ml}}$.

Tungsten, discovered by Scheele in 1781, is a metal, not found pure in nature, but obtainable by chemical operations; it is of a greyish-white color; has considerable lustre; is brittle, and infusible except at an intense heat. It has the high specific gravity of 17·5. With oxygen it forms two compounds, the dark *brown oxide*, consisting of 100 tungsten and 16 oxygen, and the *yellow*, or *tungstic acid*, constituted of the same proportion of metal and 24 oxygen; or, according to the oxygen scale, the former consists of 1 proportion of metal (12·5) united with 2 proportions of oxygen, and the latter of the same proportion of metal with 3 of oxygen. This last forms a native combination with lime, and also with iron and manganese. Its equivalent is 15·5; its symbol $\dot{\mathrm{Tn}}$; that of the metal Tn.

Columbium, or Tantalum, discovered by Hatchett in 1801, is a very rare metal, existing chiefly in *tantalite* and *yttro-tantalite*. When extracted by chemical processes, it has the form of a grey powder, which, by pressure, acquires a metallic lustre, and then exhibits an iron-grey color. This metal takes fire when heated in contact with air, and burns into *columbic acid*, which is constituted of 182 metal and 24 oxygen. There is also an *oxide*, composed of the same proportion of columbium united with 16 oxygen. The equivalent of the metal, by the oxygen scale, is therefore 22·75. The symbol for the metal is Cl.; for the acid, $\dot{\mathrm{Cl}}$.

Antimony has been known ever since the fifteenth century, when it was discovered by Basil Valentine. It is principally obtained from the native sulphuret called *crude antimony.* It is brittle, of a white color, with a shade of bluish grey. Its specific gravity is 6·7; it is fusible at 810 F., and, on cooling, sometimes forms crystals. If heated out of contact with atmospheric air, it is not volatile; but when air is present, it inflames at a white heat, and forms an oxide, which condenses in white needles, formerly called *flowers of antimony.* It forms three oxides. The first, protoxide, consists of 64 metal + 12 oxygen. The other two, from combining with certain bases, have been called antimonious and antimonic acids, consisting respectively of 64 metal + 16 oxygen, and 64 + 20. By the oxygen scale the equivalent of the metal is 8; that of the oxide combinations, in the order above named, as follows: 1 atom metal + 1½ atom oxygen = 9·5; 1 atom metal + 2 atoms oxygen = 10; 1 atom metal + 2·5 atoms oxygen = 10·5. The symbol of antimony is St (Stibium); that of the protoxide, $\underline{St}$; that of the deutoxide, $\underset{\cdot}{S}t$.

Uranium. Klaproth in 1789 first pointed out this metal in a mineral found in Saxony, called *pitchblende*, from which it may be extracted by chemical processes. Its metallic properties are faintly marked, but it has some lustre. It is not changed by air at common temperatures; but, when heated in an open vessel, it absorbs oxygen, and is converted into protoxide. The equivalent number of the metal, arrived at by indirect processes, is not made the same by different chemists. The result obtained by Dr. Thomson is 208, or 26, if oxygen be unity, — which, with one atom oxygen, forms the protoxide, equivalent 27, and with 2 atoms oxygen, the peroxide, equivalent 28. Symbols: for the metal, Ur; for the protoxide, $\underline{U}r$; for the peroxide, $\underset{\cdot}{U}r$.

Cerium was discovered in 1803, by Hisinger and Berzelius, in a rare mineral called *cerite*, and subsequently by Dr. Thomson, in a mineral called *allanite*, in honor of the late Mr. Allan, who first showed it to be a distinct species. In a metallic state, the properties of cerium are very imperfectly known. Its equivalent number has been stated at 48, and it forms two oxides — the *protoxide*, of a white color; the *peroxide*, of a fawn red. By the oxygen scale the equivalent of the metal is 6; that of the peroxide 7; that of the protoxide 6·5. The oxides enter into the composition of several mineral species.*

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* As the compounds of cerium, which have been hitherto examined, probably contained lanthanium and didymium, (the new elements alluded to on page xcv) it is doubtful whether its received atomic weight is the true one, and the former experiments now seem to require revision. [Am. Ed.]

Symbols: for the metal, Cr; for the peroxide, $\underset{\cdot}{\mathrm{C}}\mathrm{r}$; for the protoxide, $\underline{\mathrm{C}}\mathrm{r}$.

Bismuth is a well-characterized metal, and can be obtained in considerable quantity. It is brittle when cold. Its color is reddish white, and it has considerable lustre; its density about 10. It fuses at 476° F., and, when slowly cooled, crystallizes in octahedrons. In close vessels it sublimes, but not under a red heat. In open vessels it burns at that temperature into a white volatile oxide, in which 72 of metal are united with 8 of oxygen. By circuitous processes, 2 equivalents of bismuth ($= 144$) may be brought to unite with 3 equivalents of oxygen. The sulphuret is a compound of 1 equivalent of each of its elements, and is found native. The equivalent of bismuth, by the oxygen scale, is 9; symbol, Bs.

Titanium was first found by Mr. Gregor of Cornwall, in 1791, in a mineral called *menaccanite*, and has since been detected in several other minerals. In 1822 Dr. Wollaston remarked it forming very small but perfect cubes in an iron slag, and it appears not to be uncommon in the refuse of iron furnaces. These small cubes have a specific gravity of 5·3; they are exceedingly hard and infusible, and of a copper-red color. They resist the action of solvents applied in the usual way, but, by particular management, the metal may be oxidized. The equivalent of the metal is 24. It appears to be susceptible of uniting with 1 equivalent of oxygen, and also with 2, the latter constituting *titanic acid*, the equivalent of which, by the oxygen scale, (the metal being 3) is 5. Its symbol is $\dot{\mathrm{T}}\mathrm{t}$; that of the metal, Tt.

Tellurium was discovered by Klaproth, about the year 1798, in an ore of gold. When extracted by artificial methods, and metallized, it is of a tin-white color, verging to lead-grey; has considerable lustre, and a foliated or scaly fracture. It is very brittle; fusible below ignition; and, excepting osmium and mercury, is the most volatile of all metals. Its specific gravity does not exceed 6·185. It is susceptible of two degrees of oxidation, both of which exhibit acid properties. The one, consisting of 1 equivalent of tellurium and 1 of oxygen, ($32 + 8$) and the other, or peroxide, of 1 equivalent metal and 1½ of oxygen, ($32 + 12$.) They are usually called *tellurous* and *telluric acids*. The symbol for the metal is Tl. The equivalent, by the oxygen scale, 4. The acids do not occur native. The *sulphurets* of tellurium are analogous compounds in the proportions in which the metal and sulphur are united.

Copper has been known from the most ancient times, and, next to iron, constitutes one of the most valuable and abundant mineral treasures. In its metallic state it is of a fine red color. It is capable of considerable lustre; is both malleable and ductile, and has a specific gravity, varying with its purity and the processes it has undergone, from 8·434 to 9·0. At 27° of Wedgewood's pyrometer it melts, and emits fumes. It has a great affinity for oxygen, and may be converted into black or protoxide by long exposure to a sufficient heat with contact of air. This compound consists of 32, or 1 equivalent of metal with 8, or 1 equivalent of oxygen, and constitutes the bases of the salts of copper. There is also a native orange-red oxide of copper, in form of octahedral crystals, in Cornwall and elsewhere, and also obtainable artificially, which is regarded as a *suboxide*. This is permanent at ordinary temperatures, but at a red heat it is converted into the black oxide. There are also *chlorides* and *sulphurets* of copper, analogous in atomic proportions to the oxides. Copper glance (the equivalent of copper being taken at 32) is a *disulphuret*, consisting of two atoms of base and one atom of sulphur. The true sulphuret, consisting of one equivalent of each element, is one of the ingredients of *copper pyrites*, in which it exists along with protosulphuret of iron. The equivalent of copper, by the oxygen scale, is 4; that of its black oxide, composed of one equivalent of copper and one of oxygen, is 5; and that of the red oxide, consisting of two equivalents of copper with one of oxygen, is 9. Symbol for copper, Cp; red oxide, $\underline{C}p$; black oxide, $\underset{\cdot}{C}p$.

Lead. This well-known metal is of a bluish-grey color, of specific gravity 11·381, very malleable, and ductile in a small degree. It melts at 612° F., and, when slowly cooled, shoots into octahedral crystals, and sometimes into perfect cubes. It is readily oxidized when exposed at high temperatures to the air. Its *protoxide*, which is yellow, and known under the name of *massicot*, is constituted of 104 lead and 8 oxygen. The *peroxide* is of a puce color, and is constituted of the same proportion of metal with 16 oxygen. The beautiful red compound, called *minium*, or *red lead*, is not a true atomic compound; but is variable as to the proportions of protoxide and peroxide which constitute it. The *sulphuret*, which is the most abundant source of the lead of commerce, consists of one equivalent of lead and one of sulphur. The equivalent of lead by the oxygen scale is 13, which combines with 1 proportion of oxygen to form the protoxide, (eq. 14) and with 2 of oxygen to form the peroxide (eq. 15). The symbol of the metal is Pl (plumbum); of the protoxide, $\underline{P}l$; and of the peroxide, $\underset{\cdot}{P}l$.

ORDER IV.

Mercury or **Quicksilver**, as is well known, is fluid at common temperatures. Its specific gravity at 47° F. is 13·545. At 39° or 40° below 0 F. it becomes a solid, which may be flattened by the hammer or cut with a knife, and has the specific gravity 15·612. At a temperature variously stated between 656° and 680° F. it boils, and is convertible into a vapor, the specific gravity of which exceeds, by very nearly seven times, that of atmospheric air. Mercury has two distinct oxides; the *protoxide*, of a black color, consisting of 200 (1 equivalent) of mercury and 8 oxygen; the second, or *peroxide*, of a fine red color, is obtained by long-continued calcination, and consists of 200 mercury and 16 oxygen. Dr. Thomson makes the equivalent of mercury one half less, or 12·5 (100 of the oxygen scale); so that the equivalent of the oxide is 13·5 for the protoxide, and 14·5 for the peroxide. Mercury also forms two definite compounds with sulphur, one of which, *cinnabar*, which is of a beautiful red color when powdered, and is then called *vermilion*, occurs native. It is a simple sulphuret, or a combination of 1 atom sulphur and 1 atom mercury. The symbol for mercury is H (Hydrargyrum).

Silver has a beautifully white color, and is inferior in lustre only to polished steel. Its specific gravity, after being hammered, is 10·51. In malleability and ductility it is superior to all the metals except gold. At 22° of Wedgewood's pyrometer it fuses, and by slow cooling forms crystals. It does not, like most other metals, enter in several proportions into union with oxygen, chlorine, or sulphur, but forms only one compound with each of those elements. In the proportion of 110 by weight to 8 oxygen, it constitutes the oxide of silver; with 36 chlorine, the *chloride;* and with 16 sulphur, the *sulphuret*. The chloride and sulphuret are native productions, and are known familiarly as *horn silver*, and *silver glance*. Silver is represented in the formulæ by the symbol Ag (Argentum). The equivalent of the metal is 13·75; of horn silver, 18·25; of the sulphuret, 15·75, by the oxygen scale. The atomic weight of silver has been put down at 108 by Berzelius and others, but the experiments of Dr. Thomson led him to fix it at 110, or

13·75 of the oxygen scale: a result now confirmed by the experiments of other chemists, who have recently been investigating the atomic weight of this and several other metals.*

Gold is the only metal which has a yellow color. Its specific gravity varies with the processes which it has undergone, but may be stated, on an average, at 19·3. It surpasses all metals in malleability and ductility. At a heat of about 32° Wedgewood it fuses, and, on cooling slowly, shoots into quadrilateral pyramids. It is not volatile at any known temperature. One of its most valuable properties is, that it may be exposed to the air for ages without change. It may, however, be oxidized by chemical processes, and unites in the proportion of 200 gold to 8 oxygen, forming *protoxide;* and of the same proportion of gold to 24 oxygen, constituting the *peroxide of gold.* The intermediate compound, or *deutoxide,* is supposed to be the purple substance which is formed when gold is burnt by intense heat or galvanic electricity. Only one *sulphuret* is known, constituted of 200 gold and 48 (3 equivalents) of sulphur. Dr. Thomson makes the equivalent of gold, by the oxygen scale, 12·5, or 100 by the hydrogen scale. (*Inorganic Chemistry,* vol. i., p. 643.) The symbol is Au (Aurum).

Platinum. This metal was known to Wood, assay-master, as early as 1741, although its properties had not been investigated at a much later period. If it were more plentiful and cheap, it would be applicable, on account of its infusibility and property of resisting most chemical agents, to a variety of valuable purposes; it is inferior in beauty and lustre to silver, but exceeds that metal and all others in specific gravity, which is between 21 and 22. Among the metals it is one of the slowest conductors of heat, and is less expansible than most of them by that agent. It is both highly malleable and ductile. It is not oxidizable, even by the long-continued action of heat and air, but may be brought to combine with oxygen by circuitous processes, which afford two well-characterized oxides. The *protoxide* consists of 96 (1 equivalent) of platinum and 8 oxygen; the *peroxide,* of the same weight of metal and 16 oxygen; and there appears also to be an intermediate oxide, consisting of 2 equivalents of platinum and 3 equivalents of oxygen. There are also chlorides and sulphurets of platinum corresponding with the above as to equivalent proportions of their elements. By the oxygen scale, 12 is the equivalent of the metal, 14 of the peroxide, and 13 of the protoxide. The symbol for platinum is Plt.

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* See London Chemical Gazette and Journal of Practical Chemistry, (Part I, December, 1842) conducted by Messrs. W. Francis and H. Croft, late students in the Universities of Berlin and Giessen.

Palladium was discovered by Dr. Wollaston in 1803, forming distinct small fragments in the native ore of platinum. He extracted it also by complex chemical processes, which he has described in the *Philosophical Transactions* for 1804. In color it resembles platinum, but is of a duller white. It is malleable and ductile; its specific gravity varies from 10·972 to 11·482. It is not fusible or oxidizable at a degree of heat sufficient to melt gold, but at a stronger heat melts, and, on cooling, affords a mass, of specific gravity 11·871. By indirect methods it combines with oxygen. Its *protoxide* is black, and consists of 54 (1 equivalent) of palladium, and 8 (1 equivalent) of oxygen; its *peroxide*, also black, is constituted of 1 equivalent of metal and 2 equivalents of oxygen; it combines with chlorine, and forms two chlorides. The equivalent of palladium, by the oxygen scale, is 6·75; its symbol is Pal.

Rhodium is also a discovery of Dr. Wollaston, made in 1804, and from the same source, as palladium. It has a white color, a metallic lustre, is brittle, extremely hard, and has a specific gravity of about 11. It attracts oxygen from the air when heated to redness, but it has the remarkable property of being insoluble in all acids, unless alloyed with other metals. Like palladium, it combines with two proportions of oxygen. The *protoxide*, which is black, and enters into the salts of rhodium, is constituted of 54 (1 equivalent) of metal, and 8 (1 equivalent) of oxygen; the *peroxide*, of 2 equivalents of metal and 3 equivalents of oxygen. By some chemists the equivalent of this metal is given as 52·2, and Prof. Brande, in the table of equivalents given in his valuable *Dictionary of Science*, records it as 45. But the experiments both of Berzelius and Dr. Thomson seem to fix it at 54, or 6·75 of the oxygen scale. Its symbol is R.

Osmium is another ingredient of the ore of platinum, in which it was discovered in 1803 by Mr. Smithson Tennant. It can only be extracted by complicated methods, which present it in the form of a black powder, susceptible of metallic lustre by friction; of the specific gravity of about 7. It takes fire in the open air, and its oxide, which is volatile, has an acrid and suffocating odor. From the experiments of Berzelius, it seems to be capable of entering into combination with several proportions of oxygen. Its equivalent number is about

100 of the hydrogen scale, or 12·50 of the oxygen. Its symbol is Os.

Iridium is another elementary metal (the fifth) which enters into the crude ore of platinum. It is evolved in the process by which osmium is separated from the same ore, and was discovered at about the same time in 1803, by Descotils in France, and Tennant in England. Its distinguishing property is the variety of colors which it exhibits (from *iris*, the rainbow). It is a very brittle metal, susceptible, when carefully burnished, of considerable polish. It is very difficult of fusion; but when fused in Mr. Children's experiments, with the aid of a powerful galvanic battery, it had the specific gravity of 18·68. It is oxidized by a red heat, but only when finely divided; and it is not easily acted upon by acids. From the researches of Berzelius, the equivalent of iridium is 98, or 12·25 of the oxygen scale; and it appears to have 3 degrees of oxidation. The rapid transition of these oxides into each other occasions the variable tints of iridium. Its symbol is Ir.

SYSTEMATIC ARRANGEMENT ADOPTED IN THE DESCRIPTION OF SPECIES.

In the absence of that organization which so admirably serves as a guide to the generic differences in animals and plants, we must seek for some other basis on which to found an arrangement of minerals. No one has yet been, nor does it seem possible that one should be, constructed, that is altogether satisfactory; — one in which there is not much that is arbitrary.

The characters of minerals are of two kinds, Physical and Chemical: every system must be founded on one or other of these, or upon their combination.

Of the Physical characters, the most valuable, because the most certain, when it exists, is Structure; and since by it alone we may often recognise a mineral, it is highly deserving of the earliest attention of the student. There are, however, many minerals in which no regular structure is visible. If, therefore, we would depend on the physical characters, we must look for some other amongst them; but there is none so invariable as structure. Therefore, any arrangement that is made to depend on the physical characters, can only be founded on a comparison of a number of them; but many, if not most, of these characters, are subject to some, and often to a considerable degree of variation, even in the same substance.

The physical characters, therefore, are not of that precise, invariable, and universal application which alone would justify their adoption as the basis of an arrangement.

of the chief difficulties attendant on the plan of arrang-
inerals according to their composition is, the uncertainty
exists in particular substances, as to what their absolutely
ial *constituents* are. It may, however, be understood,
hatsoever enters into the composition of a mineral, that
ot alter the external form and internal structure of that
nce in its purer state, is not an essential element, but an
ntal ingredient. Thus, among earthy minerals, the
s coloring matters of quartz, and in the rhombic calca-
spar of Fontainbleau, the sand it encloses, which is said
ount to one-fifth of the whole weight of the mineral, are
accidental ingredients. Among metalliferous minerals,
copper or fahlerz may be cited as an instance of remark-
liversity of composition, without any alteration of external
for, besides copper, iron, and sulphur, it sometimes
les a proportion of arsenic, lead, silver, or antimony.
other instances might be cited.*

other difficulty arises from the still progressive state of
istry. Hence new analyses, whenever they offer new
s, tend to a perplexity of choice, which can only be termi-
by selecting those which have been obtained by the
s of the most eminent analysts, and are founded on the
ior resources of modern analytic chemistry.

t although these difficulties are attendant upon a reliance
ie chemical characters as the basis of an arrangement,

a more or less certain criterion for determining the relative ages of the earths and the metals.

Some of the earths chiefly constitute those rocks which are esteemed to be of the oldest formation, while others do not enter into the composition of rocks, being found only in the veins which traverse them; these therefore may be estimated as of later origin than the former.

Of the alkalies and acids as mineral constituents, either combined with the earths or with each other, the former claim the precedence, as entering into the composition of the oldest rocks.

Two or three of the metals occur in small quantity in the masses of some of the earlier rocks; but in general the metals are found in veins; some in veins traversing the older rocks, and rarely or never in those of a more recent description; others most abundantly or only in those of newer formation.

As rocks are constituted chiefly of earths, and metals are principally found in veins, earthy minerals may be assumed to be of earlier origin than the metalliferous; hence minerals appear to possess a claim to a somewhat *natural order of succession in our cabinets.*

Thus siliceous minerals are first described, because it is estimated that silica forms the largest proportion of the oldest and most abundant primitive rocks, and all earthy minerals of which silica is the largest ingredient, are arranged under that head; beginning, chemically, with silica in its purest form, and proceeding to such as consist of this acid combined with some earth, as magnesia, alumina, or lime,—forming a silicate of alumina, magnesia, or lime,—and afterwards to such minerals as are chiefly constituted of three or more earths, terminating with the most compound; regarding the iron, manganese, &c. involved in many of these combinations, sometimes as accidentally present, and at others as essential, or combined as isomorphous constituents, according as they are represented by the formulas. The other earthy minerals, are proceeded with in like manner; arbitrarily selecting such as contain the rare earth glucina, and placing them under that head, except that the gadolinite, which also contains the still more rare earth yttria, is placed under the latter.

Next after those minerals which consist only of one or more of the earths, succeed those in which one or other of the alkalies is found; to these, such of the acids as occur in the concrete state; then those minerals which are primarily constituted of one or more earths and an acid; and after these those consisting of an alkali and an acid; and, finally, the very few in which an earth, an alkali, and an acid, are combined together.

ne native metals and metalliferous minerals succeed, ar- ed according to the order of age and formation, subordi- y beginning with the metal in its native state, when it so rs; then its combination with other metals, when in the of a natural alloy; then combined with sulphur, with en, and finally, as an oxide combined with an acid.

ne combustibles follow, beginning with sulphur, to which eeds carbon in its purest form, and afterwards its several binations with other bodies, as the base of the greater part the substances belonging to this class.

ne order of arrangement is therefore as follows:

EARTHY MINERALS.
ALKALINO-EARTHY MINERALS.
ACIDS.
ACIDIFEROUS EARTHY MINERALS.
ACIDIFEROUS ALKALINE MINERALS.
ACIDIFEROUS ALKALINO-EARTHY MINERALS.
NATIVE METALS AND METALLIFEROUS MINERALS.
COMBUSTIBLES.

ATOMIC CONSTITUTION OF MINERALS.

			Atoms.	Ratio.
40·55 Silica,	divided by 2·	give	20·27	2
20·10 Alumina,	" 2·25	"	8·93	9·93..1
5·00 Peroxide of iron,	" 5·	"	1·00	
34·86 Lime,	" 3·5	"	9·95	10·05..1
0·48 Protoxide of manganese,	" 4·5	"	0·10	

In calculating from the quantities of oxygen, we obtain the same result, as here shown:

40·55 Silica,	contain	of oxygen,	21·06	2
20·10 Alumina,	"	"	9·38	10·71..1
5·00 Peroxide of iron,	"	"	1·33	
34·86 Lime,	"	"	9·79	9·90..1
0·48 Protoxide of manganese,	"	"	11	

It has already been shown in the table of isomorphous bodies, page lxxxiv, that peroxide of iron is isomorphous with alumina, and protoxide of manganese with lime. These substances are therefore united in the above calculations. The atoms of silica are very nearly twice those of all the bases, and the sums of these last are nearly equal to each other. The mineral, therefore, consists of simple silicates, or one atom silicate of alumina, one atom silicate of lime. Formula: $\mathrm{AlS}+\mathrm{CalS}$. Sometimes the atoms of silica, or other acids, amount to more than those of the bases, in which cases we have *bisilicates* and *tersilicates;* and sometimes they are less, in which cases we have *disilicates*, *trisilicates*, *&c.* Numerous examples of these will be shown in the body of the work; but we will here refer to one or two. Wiegmann's analysis of axinite, page 47, gives of

	Atoms.
Silica	22·50
Alumina	8·44
Lime	3·57
Protoxide of iron	2·72
Protoxide of manganese	2·00
Magnesia	0·1
Boracic acid	0·66

Here the atoms of silica and boracic acid, are 23·16, while those of the bases, are 16·83, showing that some of the latter must be in the state of bisilicates. If 8·44 atoms of silica are combined with the alumina to form a simple silicate, there will remain 14·72 atoms alumina, to be divided among the other bases. These amount to 8·39 atoms; but the boracic acid is supposed to be united with the lime and magnesia, and thus we have only 7·73 atoms remaining. The atoms of silica are now so nearly twice those of these bases, that it is evident the latter exist as bisilicates. We have then, one atom simple silicate of alumina, one atom bisilicate of lime, iron and manganese. Formula: $\mathrm{AlS}+(\mathrm{Cal}, \underline{\mathrm{F}}, \underline{\mathrm{M}}\mathrm{n})\mathrm{S}^2$.

Berthier's analysis of Adularia (page 193), divided by the atomic weights, gives these numbers:

		Atoms.
Silica	32·1	11·3
Alumina	8·17	2·9
Potash	2·82	1·

re the atoms of silica are almost exactly three times as rous as those of the bases, while those of the potash, are ose of the alumina, nearly as 1 to 3. Pure felspar, there- consists of three atoms tersilicate of alumina, one atom cate of potash. Formula: $3AlS^3+KS^3$.

we take Andalusite (page 118), we have very nearly two s of alumina to one atom of silica, or a *disilicate* of alumina. if we take Arfwedson's analysis of sappare (page 106), ave 18·50 atoms of silica, 27·77 atoms alumina; or silica m, alumina 1·5 atoms. This, according to Dr. Thomson, *ubsesquisilicate* of alumina. Formulas: Al^2S. $Al^{1\frac{1}{2}}S$.

nong the metals, if we take the four analyses of sulphuret pper (page 475), the mean atoms of the metal, are 19·66, e those of sulphur, are 9·52. The proportions here being ly as two of the former to one of the latter, the mineral is *ulphuret*. Formula: Cp^2Sl.

. Phillips' analysis of Varvacite (page 391), divided by the ic weights, gives 18·02 atoms protoxide of manganese, 8 atoms oxygen, 4·8 atoms water; equivalent to 8·96 atoms xide of manganese, 9·08 atoms sesquioxide, 4·8 atoms r. Or, the mineral consists of two atoms binoxide, two s sesquioxide, one atom water. Formula: $2\underset{\cdot\cdot}{Mn}2\underset{\cdot}{Mn}+Aq$.

hese are some of the simplest examples. There are others h are rendered more difficult in apportioning the silica, or r acids, among the bases, when the latter are numerous,

A TABLE

Comprising the Names of the Substances which enter into the Composition of Minerals; with their Symbols and Atomic Weights, or Combining Equivalents.

NAMES OF SUBSTANCES.	SYMBOLS.	ATOMIC WEIGHTS.*	
		Thomson. Oxygen=1	*Berzelius.* Oxygen=100.
Gold (Aurum)	Au	12·5	1243·01
Silver (Argentum)	Ag	13·75	1351·61
Arsenic	As	4·75	470·04
Arsenious acid	$\bar{A}s$	6·25	1240·08 As^2O^3 or $\overset{\cdots}{As}$
Arsenic acid	$\dot{A}s$	7·25	1440·08 As^2O^5 or $\overset{\vdots\vdots}{As}$
Ammonia	Am	2·125	214·47
Alumina	Al	2·25	642·33 Al^2O^3 or $\overset{\cdots}{Al}$
Boron	B	1	136·25
Boracic acid	$\dot{B}$	3	436·20 BO^3 or $\overset{\cdots}{B}$
Barytes	Br or Ba	9·5	956·88
Bismuth	Bs or Bi	9	886·92
Oxide of Bismuth	$\underset{\cdot}{B}s$	10	986·92
Bromine	Bro	4·5	489·15
Cadmium	Ca or Cd	7	696·77
Carbon	C	0·75	76·44
Carbonic acid	$\dot{C}$	2·75	276·44
Chromium	Ch or Cr	4	351·82
Oxide of Chromium	$\underset{\cdot}{C}h$	5	1003·63 Cr^2O^3 or $\overset{\cdots}{Cr}$
Chromic acid	$\dot{C}h$	6·5	651·81
Columbium (Tanta.)	Cl or Ta	22·75	2307·43
Columbic acid	$\dot{C}l$	25·75	2607·43
Lime (Calx)	Cal	3·5	356·02
Cerium	Cr or Ce	5·5	574·70
Protoxide of Cerium	$\underline{C}r$	6·5	674·70
Peroxide of do.	$\underset{\cdot}{C}r$	7	1449·49 Ce^2O^3 or $\overset{\cdots}{Ce}$

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* These atomic weights have been selected from Dr. Thomson's System of Inorganic Chemistry, vol. i. p. 713, seventh edition, 1831; and from Berzelius' Théorie des Proportions Chimiques, edition for 1835. They represent only those substances which most directly concern mineralogy. (AM. ED.)

NAMES OF SUBSTANCES.	SYMBOLS.	ATOMIC WEIGHTS.	
		Thomson. Oxygen=1	*Berzelius.* Oxygen=100.
balt	Cb or Co	3·25	368·99
ide of Cobalt	C̣b	4·25	468·99
pper	Cp or Cu	4	395·70
d or suboxide of Copper	C̲p	9	891·39
ck or protoxide of Copper	C̣p	5	495·70
lorine	Chl or Cl	4·5	442·65
n (Ferrum)	F or Fe	3·5	339·21
toxide of Iron	F̲	4·5	439·21
oxide of Iron	F̣	5	978·41 Fe^2O^3 or F̈e
oric acid	Ḟl	2·375	246·30
cina	G	3·25	962·52 G^2O^3 or C̈
rcury (Hydrar.)	H or Hg	12·5	1265·82
lium	I or Ir	12·25	1233·50
ash (Kali)	K	6	589·92
hia	L	1·75	180·33
llitic acid	Ṁel	6·5 ?	
lybdenum	Ml or Mo	6	598·52
lybdic acid	Ṁl	9	898·52

NAMES OF SUBSTANCES.	SYMBOLS.	ATOMIC WEIGHTS.	
		Thomson. Oxygen=1	*Berzelius.* Oxygen=100.
Rhodium	R	6·75	651·39
Silica	S or Si	2*	577·31 SiO^3 or $\dddot{\mathrm{Si}}$
Sulphur	Sl or S	2	201·17
Sulphuric acid	$\dot{\mathrm{S}}\mathrm{l}$	5	501·16
Selenium	Sel or Se	5	494·58
Selenic acid	$\dot{\mathrm{S}}\mathrm{el}$	8	794·58
Antimony (Stibium)	St or Sb	8	806·45
Protoxide of do.	$\underline{\mathrm{S}}\mathrm{t}$	9·5	1912·90 Sb^2O^3 or $\dddot{\mathrm{S\!\!\!-}}\mathrm{b}$
Deutoxide of do.	$\underset{\cdot}{\mathrm{S}}\mathrm{t}$	10	2012·90 Sb^2O^4 or $\overset{::}{\mathrm{S\!\!\!-}}\mathrm{b}$
Tin (Stannum)	Sta or Sn	7·25	735·29
Oxide of Tin	$\underset{\cdot}{\mathrm{S}}\mathrm{ta}$	8·25	835·29
Strontian	Str	6·5	647·29
Tellurium	Tl or Te	8	801·76
Tungsten (Wolfm.)	Tu or W	12·5	1183·00
Tungstic acid	$\dot{\mathrm{T}}\mathrm{u}$	15·5	1483·00
Titanium	Tt or Ti	3·25	303·66
Titanic acid	$\dot{\mathrm{T}}\mathrm{t}$	5·25	503·66
Thorina	Th	8·5	844·90
Vanadium	Vn	8·5	856·89
Vanadic acid	$\dot{\mathrm{V}}\mathrm{n}$		1156·89 VO^3 or $\dddot{\mathrm{V}}$
Uranium	Ur or U	26	2711·36
Protoxide of do.	$\underline{\mathrm{U}}\mathrm{r}$	27	2811·36
Peroxide of do.	$\underset{\cdot}{\mathrm{U}}\mathrm{r}$	28	5722·72 U^2O^3 or $\dddot{\mathrm{U\!\!\!-}}$
Water	Aq or $\dot{\mathrm{H\!\!\!-}}$	1·125	112·48
Zinc	Z or Zn	4·25	403·23
Oxide of Zinc	$\underset{\cdot}{\mathrm{Z}}$	5·25	503·23
Zirconia	Zr	3·75†	1140·40 Zr^2O^3 or $\dddot{\mathrm{Z}}\mathrm{r}$‡
Yttria.	Y	5·5§	502·51

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* The atomic weight of silicium being regarded as 1, and silica as a protoxide, or consisting of single atoms of its elements. But Berzelius' numbers answer to one atom base and three atoms oxygen. In dividing, therefore, by his atomic weights, these differences, as noted by the formulæ, must be observed.

† Considered as a protoxide, the eq. of the metal being 2·75.

‡ The equivalent for the metal, by this scale, being 420·20.

§ The equivalent numbers answering to hydrogen as unity, may be obtained by multiplying any of the numbers in the first column of weights by 8.

Atomic Constitution.	Specific Gravity.	Hardness.
	2·6	7
	2·525	7
	2·09—2·35	6·75
	1·8	6—7
$\underline{\mathrm{I}}\mathrm{n},\underline{\mathrm{F}})\mathrm{S}^{1\frac{1}{3}}+6\mathrm{Aq}$	2·935	5
	4·2	6·5—7·5
$+(\underline{\mathrm{F}},\mathrm{Cal},\mathrm{Mg})\mathrm{S}$	3·515	7·5
	3·372	6·75
	3·23	6·75
	3·44	7·5
$+\underline{\mathrm{F}}\mathrm{S}+\underline{\mathrm{M}}\mathrm{nS}.$	3·6	7·5
$\underline{\mathrm{F}},\mathrm{Cal},\underline{\mathrm{M}}\mathrm{n})\mathrm{S}$	3·07	6·75
	3·87—3.96	6·5
$\mathrm{Mg},\mathrm{Cal},\mathrm{Chr},)\mathrm{S}+3(\underline{\mathrm{F}},\underline{\mathrm{M}}\mathrm{n})\mathrm{S}^2$	3·8	7·5
	3·8—3·4	6·5
lS	3·221	2
$\mathrm{lS}+\mathrm{Aq}$	2·98—3·02	5·5—6
$\mathrm{S}^{1\frac{1}{3}}+\frac{1}{2}\mathrm{Aq}$	2·926	6—7

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
12. Stilbite	$3AlS^3+CalS^3+6Aq$	2·0—2·2	3·5—4
13. Heulandite . . .	$5AlS^3+CalS^3+6Aq$	2·20	3·5—4
14. Davyne	$5AlS+CalS^2+2Aq$	2·4	5—5·5
15. Laumonite	$3AlS^2+Cal^2+4Aq$	2·3	4 above, when fresh.
16. Zoisite	$2AlS+CalS$	3·2—3·3	6—7
17. Epidote	$4AlS+3CalS+2\underline{F}S$	3·42	6—7
18. Axinite	$AlS+(Cal, \underline{F}, \underline{M}n)S^2$	3·27	6·5—7
19. Isopyre	$3AlS^2+2\underset{.}{F}S^2+2CalS$	2·9—3·0	6—6·5
20. Indianite	$3AlS+CalS$	2·74	6·5—7
21. Anthophyllite . . .	$3MgS^2+\underline{F}S^2$	3·0—3·3	5—5·5
22. Amphodelite . . .	$3AlS+(\frac{11}{21}Cal+\frac{8}{21}Mg+\frac{2}{21}\underline{F})$	2·76	4·5
23. Zeuxite	$3AlS+\underline{F}^2S+Aq$	3·051	4·25
24. Bonsdorfite . . .	$3AlS(+\frac{3}{4}Mg+\frac{1}{4}\underline{F})S^2+2Aq$		3·5
25. Anorthite	$7AlS+2CalS+MgS$	2.65	6
26. Pyrophyllite . . .	$8AlS^2+MgS^2+3Aq$	2·8	1·5
27. Fahlunite	$3AlS+(\frac{6}{10}Mg+\frac{3}{10}\underline{F}+\frac{1}{10}\underline{M}n)S^2+2Aq$	2·6—2·7	3
28. Iolite	$3AlS+MgS^2$	2·56	7—7·5
29. Hydrous Iolite . . .	$3AlS+(\frac{3}{4}Mg+\frac{1}{4}\underline{F})S^2Aq$	2·705	2—5
30. Harmotome . . .	$4AlS^3+BS^3+6Aq$	2·35—2·4	4·5
31. Morvenite . . .	$5AlS^4+CalS^4+11Aq$	2·50	4·75 ?
32. Brewsterite . . .	$3AlS^3+(\frac{1}{3}Br+\frac{2}{3}Str)S^3+6\frac{1}{2}Aq$	2·1—2·4	5—5·5
33. Tabular Spar . . .	$CalS^2$	2·86	4·5—5

$\underline{M}nS^3+2\underline{F}S^3$	3·5	4·5
gS^2	3·0—3·1	5—6
$S^3+\underline{F}S$	3·07	6·5 about.
(AlS)	2·740	5·5
S^3	3·4—3·5	6
$al+\frac{1}{3}Mg)S^4+2\frac{1}{2}Aq$	2·476	4·25
S^2+CalS^2+1Aq	3·137	6—6·5
	2·6—2.8	3·5—4
S	3·3	4—5
	3·9	9
	3·43	6—6·5
	2·06—2·17	3·25
$S+10Aq$	1·8—1·9	3
	3·5—3·7	5—7
	3·1	8·5
	3·58	7
	3·3—3·9	7—7·5
	4·1—4·3	8

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
56. Dysluite	$5\underset{.}{F}Al+2\underset{.}{Z}Al+\underline{M}nAl$	4·5	4·551
57. Pyrosklerite	$2(Mg\underline{F})S+(Al\underset{.}{C}h)S+1\frac{1}{2}$	2·74	3·5
58. Hydrous Bucholzite . .	$5AlS+Aq$	2·855	3
59. Pholerite	$1\frac{1}{2}AlS+Aq$	2	1·2
60. Andalusite . : .	Al^2S	3·16	7·5
61. Stellite	$4CS^2+MS^2+AlS+2\frac{1}{2}Aq$	2·612	3·25
62. Dysclasite	$5CalS^4+CalS^2+9Aq$	2·28—2·36	4·5—6
63. Anhydrous Scolezite . .	$3AlS+CalS^3$		6
64. Vermiculite	$2MgS^2+AlS^2+\underset{.}{F}S^2+3Aq$	2·525	1·1
65. Topaz	$3AlS+Al\dot{F}l$	3·49—3·56	8
66. Hydrotalcite . : .	$3\dot{M}g^2\ddot{C}+2\dot{M}g^3\dddot{\underline{Al}},\ \dddot{\rlap{-}F}e+24\dot{\rlap{-}H}$. —*G. Rose*		2
67. Polyadelphite	$5CalS+4(\frac{5}{6}\underline{F}+\frac{1}{6}\underline{M}n)S+2MgS+AlS$	3·76	3·75
68. Spinel	$MgAl^6$	3·5	8
69. Saphirine . . : .	$AlS+(Mg, Cal, \underline{F})Al^3$	3·42	7—8
70. Chrysolite	MgS	3·3—3·5	6·5—7
71. Hydrate of Alumina : .	$AlAq$	2·55 ·	1—1·5
72. Hyalosiderite . . .	$2MgS+\underline{F}^2$	2·875	5·5
73. Condrodite. Brucite }	$Mg^2\rlap{-}Fl+3\dot{M}g^3\dddot{S}i$. — *Seybert.*	3·15—3·22	6·5
Maclurite } .	$Mg\rlap{-}Fl+2\dot{M}g^3\dddot{S}i$. — *Rammelsberg.*		
74. Serpentine	$MgS^{1\frac{1}{4}}+Aq$	2·5—2·56	3
75. Nephrite	$MgS^{1\frac{1}{4}}+Aq$	2·9—3	7

$S^3+\frac{1}{2}Aq$	2·7—2·8	1—1·5
q	2·58—2·66	2·5—3
	2·41	3
	2·97	3·5
	4·5—4·7	7·5
en. $3AlS+ZrS$.—*Muir.*	3·41	6—6·5
	3·06	7·5
^{3}	2·73	7·8—8
Al	3·65—3·8	8·5
$Cr)S$	4·3	6·5—7
	2·969	6
$l, \underline{F}, \underline{M}$, &c.$)S+1\frac{1}{4}Aq$	4·63	Not scratched by the knife.
$l\ddot{S}i+12\dot{\underline{H}}$.—*Gmelin.*	2.162	5—5·5
	2	7·5 Shepard.
Aq	2·73	Between Mica and Calc Spar.
$\underline{M}n)S^2+Aq$	4·40	Scratches glass with difficulty.
	2·975	3—4
alS	2·666	About the same as Rock Crystal.
$3(\frac{3}{4}\underline{F}+\frac{1}{4}Al)S^2+11Aq$		2·75
$n)S^3+3AS+Aq$	2·709	3—5

CLASS II. ALKALINO-EARTHY MINERALS.

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
1. Common Mica . .	$15AlS+1\frac{1}{2}KS^3+FS^3$	2·85	2—2·5
2. Leucite	$3AlS^2+KS^2$	2·48—2·5	5·5—6
3. Phillipsite	$4AlS^2+(\frac{2}{3}Cal+\frac{1}{3}K)S^2+6Aq$	2	4·5
4. Apophyllite . . .	$7CalS^3+KS+15Aq$	2·3—2·5	4·5—5
5. Weissite	$2AlS^2+1(\frac{3}{11}Mg+\frac{2}{11}K+\frac{1}{11}\underline{F})S^2+\frac{1}{2}Aq$	2·80	Scratches glass.
6. Pearlstone . . .	$6AlS^5+S\underset{\cdot}{F}^4+CalS^4KS^4+4Aq$	2·34	6—6·5
7. Gieseckite	$6AlS+KS^3$	2·78—2·85	3·5
8. Pinite	$8\frac{1}{2}AlS^2+KS^2+2(\frac{9}{20}F+\frac{11}{20}Mg)S+Aq$	2·78—2·8	2—2·5
9. Bytownite	$5AlS+(\frac{11}{12}Cal+\frac{1}{12}Mg)S^2+(N+\underset{\cdot}{F})S^2$	2·801	6
10. Couzeranite . . .	$6AlS+(K, N)S^2+2(Cal, Mg)S^3$	2·69	6·5
11. Felspar	$3AlS^3+KS^3$	2·5—2·6	6
12. Glassy Felspar. Ryacolite .	$4AlS^3+(\frac{5}{9}K+\frac{4}{9}N)S^3$	2·58	6
13. Petalite	$2AlS^4+LS^4$	2·44	6
14. Spodumene . . .	$4AlS^2+LS^2$	3—3·2	6·5—7
15. Latrobite	$5AlS+(\frac{2}{3}Cal+\frac{1}{3}K)S$	2·8	5·5
16. Agalmatolite . . .	$13AlS+KS+4Aq$	2·8—2·85	Soft.
17. Killinite	$9AlS^{1\frac{1}{2}}+(\frac{1}{3}K+\frac{2}{3}\underline{F})S^2+4Aq$	2·65—2·75	4
18. Glaucolite . . .	$3AlS^2+(Cal, K)S^2$	2·72—2·9	5
19. Mesotype	$3AlS+NS+2Aq$	2·24—2·5	5—5·5
20. Thomsonite . . .	$3AlS+CalS+2\frac{1}{2}Aq$	2·35	5
21. Peristerite . . .	$4(AlS^5)3(KS^5)$,or$AlS^5+(Cal, Mg)S^5$	2·568	3·75

		glass.
$,)S^2+6AS+2Aq$	2·72	Between Calc Spar and Gypsum.
$S+2CalS^3)$	2·974	About that of Fluor Spar.
$)S^3+3AlS^2+7Aq$	2—2·1	4·5
$lS^3+NS^2 8Aq$.—*Berzelius.*	2·35	3·5
$l, N)S^3+3Aq$	2·25	5—5.5
$lS^2+NS+9Aq$	2·35—2·4	5—5·5
$lS+6Aq$	2·14	Does not scratch glass.
lS^3+5Aq	2·2—2·25	4—4·5
lS^2+6Aq	2·31	3
$alS^2+MgS^2+(N, \underset{\cdot}{F})S$	3—3·1	6·25—7
$K, N)S+(Al, \underset{\cdot}{F})S$.–*Damour*	3·104	6·5
	2·5—2·6	6
$Cal, K)S+2Aq$	2·3	5—6
$Cal+\frac{1}{6}\underline{F}+\frac{1}{6}K)S$	2·8	4—5
$+\frac{5}{6}N)S$	2·54—2·62	5·5—6
$\dddot{A}l\dddot{S}i+2\dot{K}\dddot{S}$.—*Kobell.*	2·68	3
$S^3+KS^3+7\frac{1}{2}Aq$	2·91	2·5
$al+\frac{1}{4}K)S^3+5Aq$	2·0964	3·75
$Cal+\frac{1}{3}N)S$	2·7	6
S^3	2·6—2·68	6

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
44. Tourmaline	$\ddot{A}l\dddot{S}i+\dot{R}^3\dddot{S}i+\dot{R}^3\dddot{B}$.—*Frankenheim.*	3—3·2	7—7·5
45. Analcime	$3AlS^2+NS^2+2Aq$	2·2—2·53	5·5
46. Sodalite	$2AlS+NS^2$	2·29—2·37	5·75
47. Scapolite. Meionite . .	$2AlS+CalS$	2·612 Dana	5—5·5
48. Pektolite	$4CalS^2+(K, N)S^3+3Aq$	2·69	4—5
49. Chabasie	$3AlS^2+(Cal, N, K,)S^2+6Aq$	2·100—2·472	4—4·5
Acadialite	$3AlS^2+(Cal, N, K,)S^3+6Aq$	2·022 Dr. Thomson.	4—2·5
50. Haydenite	$3(Al, \underset{\cdot}{F})S^3+(K, Cal, Mg,)S^2+(3Aq\,?)$	2·265 B. Silliman, Jr.	3 according to B. Silliman, Jr.
51. Caporcianite . . .	$(Cal, \dot{M}g, K, N,)S^2+3AlS^2+3Aq$		5?
52. Phakolite	$(Cal, Mg, K, N,)S^3+2AlS+3Aq$		3·75?
53. Levyne	$S(Cal, N, K)+3AlS^2+5Aq$	2·198—2·2	4
54. Achmite	$3\underline{F}S^2+NS^3$	3·5	6—6·5
55. Edingtonite . . .	$4AlS+CalS^2+4Aq$	2·75	4—4·5
56. Cummingtonite . . .	$3\underline{F}S+NS^3+\underline{M}nS^3+1\frac{1}{2}Aq$	3·20	2·75
57. Lehuntite	$3AlS^2+(\frac{8}{9}N+\frac{1}{9}Cal)S^2+3Aq$	1·953	3·75
58. Eudyalite	$ZS^3+3(N, Cal, \underline{F})S^2$	2·89	5—5·5

CLASS III ACIDS.

1. Sulphuric acid . . .	$\dot{S}l$ or $\dddot{S}$	occurs combined	with water.
2. Boracic acid . . .	$\dot{B}$ or $\dddot{B}$	1·48	1
3. Arsenious acid . . .	$\overline{A}s$ or $\dddot{A}s$	3·69	1·5

q	1·66	2?
Aq	1·66	2
$-5Aq$	2·337	3·5—4
$\dot{P}h+5Aq$	3·38	3—4
$-Mg^2\dot{P}h+1\frac{1}{2}Aq$	3—3·1	5—6
$2\frac{1}{2}Aq$	2·8—3	5—6
	2·719	3
lC	2·85—2·9	3·5—4
$-\dot{C}$	2·83	3·2
$Mg\dot{C}+3\underline{F}\dot{C}$	2·95—3·1	3·5—4
$+Cal\ Chl, \dot{F}l$	3·1—3·3	5
	3—3·3	4
	2·5—2·9	3—3·5
Aq	3·26—2·4	1·5—2
q		
$Cal\dot{B}^2+2\frac{1}{2}Aq$	2·9—3·3	5—5·5
$Br\dot{S}$	3·75	
$\frac{1}{2}Aq$	2·64—2·8	2—2·5
$\frac{1}{2}Aq$	2·84	2—2·5

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
20. Oxalate of Lime . .	$\mathrm{Cal\dot{O}+Aq}$	1·83	2·75
21. Tungstate of Lime . .	$\mathrm{Cal\dot{T}n}$	6—6·1	4—4·5
22. Carbonate of Magnesia .	$\mathrm{Mg\dot{C}}$	2·8	2—4
23. Breunnerite	$\mathrm{(Mg,\ \underline{F},\ \underline{M}n)\dot{C}}$	3—3·2	4—4·5
24. Sulphate of Magnesia .	$\mathrm{Mg\dot{S}l+7Aq}$	1·66—1·75	2·25
25. Wagnerite	$\mathrm{Mg^{2}\dot{P}h}$	3·11	5—5·5
26. Boracite	$\mathrm{Mg\dot{B}^{2}}$	2·56—3	7
27. Hydro-Boracite . .	$\mathrm{Cal\dot{B}^{2}+Mg\dot{B}^{2}+5\frac{1}{2}Aq}$	1·9	1.5—2
28. Carbonate of Barytes .	$\mathrm{Br\dot{C}}$	4·3	3—3·5
29. Baryto-Calcite . .	$\mathrm{4Br\dot{C}+4Cal\dot{C}+Mn\dot{C}}$	3·6—3·7	4
30. Bicalcareo-Carbonate of Barytes	$\mathrm{2Cal\dot{C}+Br\dot{C}}$	3·718	2·25
31. Sulphate of Barytes . .	$\mathrm{Br\dot{S}}$	4·41—4·67	3—3·5
32. Strontianite . . .	$\mathrm{10Str\dot{C}+Cal\dot{C}}$	3·6—3·8	3·5
33. Barystrontianite . .	$\mathrm{4Str\dot{C}+Br\dot{S}l+\frac{1}{4}Cal\dot{C}}$	3·7	3·5
34. Baryto-Sulphate of Strontian	$\mathrm{7Str\dot{S}+3Br\dot{S}l}$	3·921	2·75
35. Celestine	$\mathrm{Str\dot{S}l}$	3·6—4	3—3·5
36. Phosphate of Yttria . .	$\mathrm{Y^{1\frac{1}{2}}\dot{P}}$	4·14—4·55	4·5—5
37. Pyrochlore. Microlite	$\mathrm{Na\not{F}l+2\dot{C}a^{4}\ddot{T}a^{3}}$.—*Rose.* $\mathrm{Cal\dot{C}l}$.—*Hayes*	4·25	5
38. Fergusonite . . .	$\mathrm{4\frac{1}{2}Y^{5}\dot{C}l+(\underline{C}r,\ Zr,\ \underline{U}r,\ \underline{F})^{5}\dot{C}l}$	5·8—5·9	5·5—6
39. Hayesine. Borocalcite .	$\mathrm{\dot{C}a\ddot{B}^{2}+6\dot{\not{H}}}$.—*Hayes.*		2

	1·5	1—1·50
l	2·112	2·5—2·75
l	1·47	1·52
	2·1	1·5—2
	1·74	2—2·5
	2·3	2
2Aq		
Aq	1·45—1·5	1·5—2

ALKALINO-EARTHY MINERALS.

l+25Aq	1·75	1·5
$\dot{S}$l+8Aq	2·7—2·75	5
g$\dot{S}$l+K$\dot{S}$l+2Aq	2·77	2·5—3
N$\dot{F}$l^2	2·96	2·5—3
l	2·75—2.85	2·5—3
l+20Aq	1·88	3
N+6Aq	1·92—1.95	2—3
l$\ddot{\dot{S}}^3$+24$\dot{H}$.—*Rammelsberg.*	1·56	1—2

CLASS VII. NATIVE METALS AND METALLIFEROUS MINERALS.

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
1. Native Iron	F (Meteoric) F mixed with Nk	7·44	4·5
2. Cubic Iron Pyrites. Yellow Iron Pyrites	FSl^2, or $\overset{''}{F}e$	4·75—5	6—6·5
3. Prismatic Iron Pyrites. White do.			
4. Magnetic Iron Pyrites . .	FSl^2+6FSl	4·4—4·7	3 5—4·5
5. Arsenical Iron	FSl^2+FAs^2	5·7—6·2	5·5—6
6. Arsenical Sulphuret of Iron and Cobalt. Danaite . .	$(F, Cb)Sl^2+(F, Cb)As^2$.—*Ramm.*	5·5—6	6
7. Pleisto-Magnetic Iron, or common Magnetic Iron ore .	$\underline{F}\underset{.}{F}^2$, or, by Berzelius, $\dot{F}e+2\ddot{\bar{F}}e$.	6·094	5·5—6·5
8. Oligisto-Magnetic Iron, or Specular Iron Ore . . .	$\underset{.}{F}$, or $\ddot{\bar{F}}e$	5—5·251	5·5—6·5
9. Franklinite	$\underset{.}{M}n\underset{.}{F}^2+\underset{.}{Z}\underset{.}{F}^2$	5—5·1	6—6·5
10. Hydrous Peroxide of Iron. Limonite. Brown Hematite	$\underset{.}{F}Aq$	3·50	5—5·5
11. Cronstedtite	$\underline{F}S+Aq$	3·3—3·35	2·5
12. Sideroschisolite	$\underline{F}^2\dot{S}+Aq$	3	2—3
13. Hisingerite	$\dot{F}e\dddot{S}i+\ddot{\bar{F}}e\dddot{S}i+6\dot{\bar{H}}$.—*Hisinger.*	3·04	
14. Yenite	$\left.\begin{matrix}\dot{C}a^3\dddot{S}i\\ 2\dot{F}e^3\dddot{S}i\end{matrix}\right\}+\ddot{\bar{F}}e^2\dddot{S}i$.—*Rammelsberg.*	3·08—4·06	5·05—6

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
15. Pyrosmalite	$\mathrm{FeCl^3+\ddot{F}e\dot{H}^6+4(\dot{F}e^3Si^2+\dot{M}n^3\ddot{S}i^2)}$	2·95—3·10	4—4·5
16. Spathose Iron . . .	$\underline{\mathrm{F}}\dot{\mathrm{C}}$	3·6—3·8	3·5—4·5
17. Phosphate of Iron . . .	$\underline{\mathrm{F}}^{1\frac{1}{2}}\dot{\mathrm{P}}\mathrm{h}+3\frac{1}{2}\mathrm{Aq}$	2·66	2
18. Heteposite	$2\underline{\mathrm{F}}\dot{\mathrm{P}}\mathrm{h}^2+\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{P}}\mathrm{h}^2+\mathrm{Aq}$	3·5	5·5
19. Sulphate of Iron . . .	$\underline{\mathrm{F}}\dot{\mathrm{S}}\mathrm{l}+6\mathrm{Aq}$	1·84—1·9	2
20. White Copperas. Coquimbite	$\underset{\cdot}{\mathrm{F}}\dot{\mathrm{S}}\mathrm{l}^2+5\mathrm{Aq}$		
21. Sulphated Peroxide of Iron .	$\underset{\cdot}{\mathrm{F}}\dot{\mathrm{S}}+6\mathrm{Aq}$		
22. Botryogene	$\underline{\mathrm{F}}\dot{\mathrm{S}}\mathrm{l}^2+3\underset{\cdot}{\mathrm{F}}\dot{\mathrm{S}}\mathrm{l}+12\mathrm{Aq}$	2·039	2·25—2·5
23. Subsesqui-arseniate of Iron .	$\underset{\cdot}{\mathrm{F}}^{1\frac{1}{2}}\dot{\mathrm{A}}\mathrm{s}+3\frac{1}{3}\mathrm{Aq}$	2·9—3	2·5
24. Diarseniate of Iron . .	$\underset{\cdot}{\mathrm{F}}^2\bar{\mathrm{A}}\mathrm{s}+6\mathrm{Aq}$	2·2—2·4	2
25. Arseniate of Iron . . .	$\underline{\mathrm{F}}\dot{\mathrm{A}}\mathrm{s}+2\underset{\cdot}{\mathrm{F}}\dot{\mathrm{A}}\mathrm{s}+6\mathrm{Aq}$	3	2·5
26. Oxalate of Iron . . .	$\underline{\mathrm{F}}\dot{\mathrm{O}}+1\frac{1}{2}\mathrm{Aq}$, or, as stated by Rammelsberg, $2\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{C}}3\dot{\mathrm{H}}$	2·13 Leonhard. 1·3 Beudant.	2
27. Tungstate of Iron . . .	$3\underline{\mathrm{F}}\dot{\mathrm{T}}\mathrm{n}+\underline{\mathrm{M}}\mathrm{u}\dot{\mathrm{T}}\mathrm{n}$	7·11—7·33	5—5·5
28. Rutile	$\underset{\cdot}{\mathrm{F}}$? $\dot{\mathrm{T}}\mathrm{t}$	4·24—4·4	6—6·5
29. Ilmenite	$\underline{\mathrm{F}}\dot{\mathrm{T}}+\underset{\cdot}{\mathrm{F}}^2\dot{\mathrm{T}}$	4·4—4·8	5—5·2
30. Titaniate of Iron . . .	$\underline{\mathrm{F}}\dot{\mathrm{T}}\mathrm{t}$ or $\underset{\cdot}{\mathrm{F}}^{1\frac{1}{2}}\dot{\mathrm{T}}\mathrm{t}$	4·427	5—6
31. Columbite	$\underline{\mathrm{F}}\dot{\mathrm{C}}\mathrm{l}+\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{C}}\mathrm{l}$, or simply $\underline{\mathrm{F}}\dot{\mathrm{C}}\mathrm{l}$	6·3—6·8	6
32. Torrellite	$2\underline{\mathrm{F}}^2\dot{\mathrm{C}}\mathrm{l}+\underline{\mathrm{M}}\mathrm{n}^2\dot{\mathrm{C}}\mathrm{l}$	4·803	4·25
33. Chromated Iron . . .	$\underline{\mathrm{F}}\bar{\mathrm{C}}\mathrm{h}+\mathrm{Al}\bar{\mathrm{C}}\mathrm{h}$, or $\underline{\mathrm{F}}\bar{\mathrm{C}}\mathrm{h}$	4·3—4·6	5·5
34. Hausmannite . . .	$\underline{\mathrm{M}}\mathrm{n}\underset{\cdot}{\mathrm{M}}\mathrm{n}^2$	4·72—4·8	5—5·5

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
35. Braunite	$\underset{\cdot}{\mathrm{M}}\mathrm{n}$	4·8—4·9	6—6·5
36. Pyrolusite	$\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}$	4·6—4·9	2—2·5
37. Grey Oxide of Manganese .	$\underset{\cdot}{\mathrm{M}}\mathrm{n}^2\mathrm{Aq}$	4·31—4·4	4—4·2
38. Psilomelane	$2\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}^6\mathrm{Br}+5\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}\mathrm{Aq}$	4—4·15	5—6
39. Varvicite	$2\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}2\underset{\cdot}{\mathrm{M}}\mathrm{n}+\mathrm{Aq}$	4·28—4·53	6·5
40. Hydrous Binoxide of Manganese	$\underset{\cdot\cdot}{\mathrm{M}}\mathrm{nAq}$; or $6\underset{\cdot\cdot}{\mathrm{M}}\mathrm{n}+2\underset{\cdot}{\mathrm{M}}\mathrm{n}+14\mathrm{Aq}$		
41. Cupreous Manganese . .	$\dot{\mathrm{C}}\mathrm{u}\dddot{\mathrm{M}}\mathrm{n}\dot{\mathrm{H}}^9+3\ddot{\mathrm{M}}\mathrm{n}^2\mathrm{H}^3$	3·15—3·25	1·5
42. Helvine	$\underline{\mathrm{F}}\mathrm{S}^2+\mathrm{CS}^2+6\underline{\mathrm{M}}\mathrm{nS}$	3·1—3·3	6—6·5
43. Silicate of Manganese . .	$\underline{\mathrm{M}}\mathrm{nS}$	4·078	6·25
44. Sesquisilicate of Manganese .	$8\underline{\mathrm{M}}\mathrm{nS}^{1\frac{1}{2}}+\underline{\mathrm{F}}\mathrm{S}^3$	3·586	6·25
45. Troostite	$3\underline{\mathrm{M}}\mathrm{nS}+\underset{\cdot}{\mathrm{F}}\mathrm{S}^{1\frac{1}{2}}+2\mathrm{Aq}$	4—4·1	5·5
46. Newkirkite	$3\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}\mathrm{Aq}+2\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}\underset{\cdot}{\mathrm{F}}^2$	3·824	3—3·5
47. Bisilicate of Manganese .	$\underline{\mathrm{M}}\mathrm{nS}^2$	3·5—3·7	5—5·5
48. Hydrosilicate of Manganese .	$\underline{\mathrm{M}}\mathrm{nS}+\mathrm{Aq}$		
49. Knebelite	$\underline{\mathrm{F}}\mathrm{S}+\underline{\mathrm{M}}\mathrm{nS}$	3·714	6.5
50. Bustamite	$2\mathrm{MnS}^2+\mathrm{CalS}^2$	3·1—3·3	7
51. Sulphuret of Manganese .	MnSl	3·95—4·05	3·5—4
52. Arseniuret of Manganese .	MnAs	5·55	5·5 ?
53. Carbonate of Manganese .	$\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{C}}$	3·3—3·6	3·5
54. Huraulite	$6\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{P}}\mathrm{h}+2\underline{\mathrm{F}}^2\dot{\mathrm{P}}\mathrm{h}+13\mathrm{Aq}$	2·27	3
55. Phosphate of Manganese .	$\underline{\mathrm{M}}\mathrm{n}^2\dot{\mathrm{P}}\mathrm{h}+\underline{\mathrm{F}}^2\dot{\mathrm{P}}\mathrm{h}$	3·4—3·8	5

	4·4—4·7	1—1·5
	6·4—6·9	6—7
$Sl+FSl^2$	4·35—4·70	4
$\dot{T}t$	3·40—3·6	5—5·5
	3·85	5·5—6
^2Fl.—*Shepard.*	3—3·14	6
$\dot{T}t+Cal\dot{T}t+\frac{1}{2}\underset{\cdot}{F}\dot{T}t$	5·14—5·5	5—6
	4·9—5	5·5
$+\underline{F}S+CalS$	3·5—4	6
$\dot{F}l+Y\dot{F}l$	3·4	4·5—7
$\ddot{S}i$.—*Scheerer.* (*p.* 419).	3·288	7
l	4·7	4 about.
l		5
$+\dot{P}h+12Aq$	3·12	2·25
$Ph+12Aq$	3·33	2—2·5
	6·5	2—2·5

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
75. Needle Ore	$\mathrm{Cu\acute{B}i+2\acute{P}b\acute{B}i}$.—*Rammelsberg.*	6·1—6·15	2—2·5
76. Oxide of Bismuth . . .	$\underset{\cdot}{\mathrm{B}}\mathrm{s}$	4·36	
77. Silicate of Bismuth . .	$\underset{\cdot}{\mathrm{B}}\mathrm{sS}^{1\frac{1}{2}}$	5·9—6	3·5—4·0
78. Telluret of Bismuth . .	$\mathrm{BsSl+2BsTel}^2$	7·2—8	Sof.
79. Ferruginous Arseniet of Bismuth	$\mathrm{3BsAs+FAs}$	3·694	5·5
80. Arsenous Acid . . .	$\dot{\mathrm{A}}\mathrm{s}$	3·6—3·71	1·5
81. Sulphuret of Arsenic. Realgar	AsSl	3·3—3·6	1·5—2
82. Sesquisulphuret of Arsenic. Orpiment	$\mathrm{AsSl}^{1\frac{1}{2}}$	3·45	1·5—2
83. Arsenical Pyrites . . .	FAs^2	7·1—7·4	5—5·5
84. Bright White Cobalt . .	$\mathrm{As^2Sl+Cb^2Sl}$, or, according to Berzelius, $\mathrm{CbSl^2+CbAs^2}$	6·23	5·5
85. Tin-White Cobalt . . .	$6\frac{1}{2}\mathrm{CbAs^2+FAs^2}$	6·4—7·7	5·5
86. Terarseniet of Cobalt . .	$\mathrm{9CbAs^3+4FAs^3}$	6—7	
87. Sulphuret of Cobalt . .	$\mathrm{CbSl}^{1\frac{1}{2}}$	6·3—6·4	5·5
88. Cobalt-Bloom . . .	$\underset{\cdot}{\mathrm{C}}\mathrm{b}^2+\dot{\mathrm{A}}\mathrm{s}+4\mathrm{Aq}$	2·9—3·1	2—2·6
89. Sulphate of Cobalt . .	$\underset{\cdot}{\mathrm{C}}\mathrm{bSl}^3+6\mathrm{Aq}$		
90. Sulphuret of Nickel . .	NkSl, or, $\acute{\mathrm{N}}\mathrm{i}$	6·45	4
91. Antimonial Nickel . .	NkSt	7·541	6
92. Sulpho-Antimonial Nickel .	$\mathrm{NkSl+NkSt}$	6·45—6·5	5—5·5

^{2}Sl, or, $NkSl^2+NkAs^2$	5	6·129
Aq		
	10·47	2·5
	9·44—9·8	3·5
	8·41—8·56	2·25
Sl	6·9—7·2	2—2·5
Sl^2	4·2—4·25	1—1·5
gSl	5·9—6·4	2—3
$\left.\begin{matrix}Ag\\Cp\end{matrix}\right\}Sl$	6·214	2—3
$StSl^3$	5·4—5·9	2·5
	5·2—5·4	2—2·5
^{2}Sl	6·25	3—4
	8	2·5
gSel		
	4·75—5·55	1—1·5
	8·5—8·9	2·5—3
	5·69—5·8	2·5—3

113. Indigo Copper . . .	$CpSl$	[illegible]	[illegible]
114. Purple Copper Ore . .	$2Cp^2Sl+FSl$. Or $\acute{F}e+\text{Ȼ}u^2$.—*Berz.*	5	3
115. Grey Copper . . .	$(St, As)Sl+3CpSl$, or, $StSl+3CpSl$	4·4—5·2	3—4
116. Tennantite	$9CpSl+(FSl^2FAs^2)$, or, $AsSl+4\frac{1}{2}CpSl$	4·375	3
117. Copper Pyrites . . .	$FSl+CpSl$	4·16—4·3	3·5—4
118. Seleniuret of Copper . .	Cp^2Sel		
119. Red Oxide of Copper . .	$\underline{C}p$ or $\dot{\text{Ȼ}}u$	5·6—6·1	3·5—4
120. Blue Carbonate of Copper .	$2\underset{\cdot}{C}p\dot{C}+\underset{\cdot}{C}pAq$. Or $\dot{C}u\ddot{C}+\dot{C}u\dot{\text{Ħ}}$.—*Berz.*	3·5—3·77	3—4
121. Green Carbonate of Copper .	$\underset{\cdot}{C}p^2\dot{C}+Aq$	3·5—4	3·5—4
122. Anhydrous Dicarbonate of Copper	$\underset{\cdot}{C}p^2\dot{C}$	2·62	4·25
123. Chrysocolla. Silico-carbonate of Copper	$\underset{\cdot}{C}p\dot{C}+\underset{\cdot}{C}pS^2Aq$. Or $\dot{C}u^3\ddot{S}i^2+6\dot{\text{Ħ}}$.— *Von Kobell.*	2—2·2	3
124. Hydrous Sesquisilicate of Copper. Dioptase . . .	$\underset{\cdot}{C}pS^{1\frac{1}{2}}+Aq$. $\dot{C}p^3\ddot{S}i^2+3\dot{\text{Ħ}}$.—*Ramm.*	3·2—3·4	5
125. Sulphate of Copper . .	$\underset{\cdot}{C}p\dot{S}l+5Aq$	2·213	2·5
126. Tetrasulphate of Copper .	$\underset{\cdot}{C}p^4\dot{S}l+5Aq$		
127. Brochantite	$\dot{C}p^3\ddot{S}l+3\dot{\text{Ħ}}$	3·78—3·87	3·5—4
128. Chloride of Copper. Atacamite	$Cu\text{Ȼ}l+3\dot{C}u+6\dot{\text{Ħ}}$.—*Berthier's analysis*	4—4·3	3—3·5
129. Hydrous Diphosphate of Copper	$\underset{\cdot}{C}p^2+\dot{P}h+Aq$	3·6—3·8	4
130. Hydrous Phosphate of Copper	$\underset{\cdot}{C}p\dot{P}h+Aq=\dot{C}u^5\dddot{\text{Ᵽ}}+5Aq$.—*Beudant.*	4·2—4·3	5
131. Thrombolite	$\underset{\cdot}{C}p\dot{P}h^3+2Aq$		

q	2·5—2·6	2
	4·1—4·28	2·5—3
	4·2—4·6	3—3·5
Aq	3·38—3·41	3·5—4
$\dot{A}$s	5·2045	
Aq	3—3·2	1—1·5
q	4—4·1	4·5—5
	17—19	2·5—3
	16—20	4—4·5
	11·5—12·5	4·5
	23·55	
	6·1—6·2	2—2·5
Tl^3	5·7	1·5—2
Tl+3Au^{2}Tl^3	8·9—10·67	Soft.
Tl^3+18PbSl	7—7·2	1—1·5
	6·5—6·8	3—3·5
Sl. 2$\overset{\prime\prime\prime}{\text{S}}$b+3$\overset{\prime}{\text{F}}$e.—*Ber-* *analysis.*		
	4·3—4·6	2
lSl	5·5—5·8	2—2·5

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
152. Plagionite	$3StSl^{1\frac{1}{2}}+2PlSl$	5·4	2·5
153. Zinkenite	$2StSl^{1\frac{1}{2}}+PlSl$	5·3—5·35	3—3·5
154. Red Antimony . . .	$\underset{\cdot\cdot}{St}+2StSl^{1\frac{1}{2}}$	4·5—4·6	1—1·5
155. Oxide of Antimony . .	$\underline{St}$	5·5—5·6	2·5—3
156. Native Lead . . .	Pl	11·352	1·5
157. Sulphuret of Lead. Galena	PlSl, or $\acute{P}b$	7·4—7·6	2·7
158. Bournonite	StSl+PlSl+CpSl	5·79—5·83	2·5—3
159. Seleniuret of Lead . .	PlSel	8·2—8·8 Haidinger. 6·7—6·8 Prof. Silliman.	
160. Plombgomme . . .	$\underline{P}lAl^6+6Aq$	6·425	4—5
161. Bitelluret of Lead . .	$PlTl^2$	8·159	
162. Carbonate of Lead . .	$\underline{P}l\dot{C}$	6·3—6·6	3—3·5
163. Sulphato-Carbonate of Lead	$\underline{P}l\dot{C}+\underline{P}l\dot{S}l$	6·8—7	2·5
164. Sulphato-Tri-Carbonate of Lead	$3\underline{P}l\dot{C}+\underline{P}l\dot{S}l$	6 2—6·4	2·5
165. Cup. Sulphato-Carbonate of Lead	$7\frac{1}{2}\underset{\cdot}{P}l\dot{S}l+5\underset{\cdot}{P}l\dot{C}+4\underset{\cdot}{C}p\dot{C}$	6·4	2·5—3
166. Oxido-Chloride of Lead .	$Pb\text{Є}l+2\dot{P}b$	7—7·1	2·5—3
167. Chloride of Lead. Cotunnite	PlChl	1·897	Slightly scratched by the nail.
168. Chloro-Carbonate of Lead .	$\underline{P}l\dot{C}+PlChl$	6—6·1	3
169. Phosphate of Lead . .	$3Pb^3\dddot{\underline{P}}+PbCh^2$.—*Beudant.*	6·9—7	3·5—4
170. Arseniate of Lead . .	$3\dot{P}b^3\dddot{\underline{A}}r+PbCh^2$.—*Beudant.*	6·9—7·3	3·5—4
171. Sulphate of Lead. Anglesite	$\underline{P}l\dot{S}l$	6·23—6·31	3
172. Cupreous Sulphate of Lead .	$\underline{P}l\dot{S}l+\underset{\cdot}{C}p+Aq$	5·3—5·4	2·5—3

	5·95—6·6	2·5
	5·75	Soft.
pCh^2.—*Beudant.*	5·8	2·5—3
	8·1	3
$-\dot{P}b^3\ddot{V}^2$.—*Berzelius.*	6·99—7·23	Scratched by the knife.
$^2Sl^3$ or $\acute{P}b^5 \left\{ \begin{matrix} \dddot{S}b \\ \dddot{A}s \end{matrix} \right\}$ *Svanberg.* $^2Sl^3$	5·88	2—2·5
Rammelsberg.	5·97	2·5
$^2Sl^3+12PlSl$, BsSl	6·29—6·32	
	4—4·2	3·5—4
	4·5	3·66
HSel	5·56	
Or $\dot{Z}n$?	5·4—5·5	4—4·5
	3·3—3·6	5
	4·2—4·5	5
	3·584—3·598	2—2·5
$+\left. \begin{matrix} \dot{C}u \\ \dot{Z}n \end{matrix} \right\} \dot{H}^3$.—*Böttger.*		

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
191. Willelmine	ZS	4·18	5—5·5
192. Sulphate of Zinc . .	$\dot{Z}\dot{S}l^{3}+6Aq$	2·036	2—2·5
193. Hopeite :	$\dot{Z}n\overset{\cdot\cdot\cdot\cdot\cdot}{P}$.—*Frankenheim.*	2·46—2·76	2·5—3
194. Marmatite	$FSl+3ZSl$, or $\overset{\prime}{F}e+3\overset{\prime}{Z}n$.—*Beudant.*		
195. Sulphuret of Cadmium .	Cd Sl	4·842	2·75
196. Native Mercury . . .	H	13·568	Liquid.
197. Native Amalgam. . .	$H^{2}Ag$, or $H^{3}Ag$	10—14·1	1—3·5
198. Sulphuret of Mercury . .	HSl	6·7—8·2	2—2·5
199. Dichloride of Mercury. .	$H^{2}Chl$	6·48	1·5—2
200. Chloride of Mercury . .	HChl		

CLASS VIII. COMBUSTIBLE MINERALS.

1. Sulphur	Sl	1·9—2·1	1·5—2·5
2. Diamond	C	3·55	10
3. Plumbago	C mixed with F	2·08—2·45	1—2
4. Anthracite	C mixed with S & Aq	1·4—1·8	2—2·5
5. Hatchetine	CH	0·916	
6. Mellite.	AlMel+4Aq	1·58—1·66	
7. Scheererite	$\left.\begin{matrix}CH^{4}\\CH^{2}\end{matrix}\right\}$	0·955, or, nearly the same as water.	Soft.
8. Ozokerite			

$e^3\dddot{\mathrm{Si}}^2$.—*Rammelsberg.*	3·5	5·5—6
$\dot{\mathrm{F}}\mathrm{e})\dddot{\mathrm{Si}}+\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{F}}\mathrm{e})^3\dddot{\bar{\mathrm{A}}}\mathrm{l}^2$ *Rammelsberg*, from *Clem-* alysis.	3·07—3·10	4—4·5
	2·555—2·594	3·5—4
$\underline{\mathrm{F}}\mathrm{S}^2$	3·385	4·75
$)^3\dddot{\mathrm{Si}}^2+\dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{Si}}^2$.—*Von Kobell*	2·8	2
	2·969	8
$)^3\dddot{\mathrm{Si}}+2\dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{Si}}^2+\dot{\bar{\mathrm{H}}}^6$.—*Flkm.*	2·75	4—4·5
$\dddot{\bar{\mathrm{S}}}\mathrm{i}^4+3\dot{\mathrm{F}}\mathrm{e}^3\dddot{\mathrm{Si}}^2+\mathrm{X}\dot{\bar{\mathrm{H}}}$.—*Berz*	3·2—3·39	4·25
Berzelius.	2·02	2
$\mathrm{L}^2\dot{\mathrm{P}}\mathrm{h}$	3·04	6
		3
	3·2	4—4·5
$\mathrm{g}\bar{\mathrm{F}}\mathrm{l}$.—*Frankenheim.* $\dot{\mathrm{M}}\mathrm{g}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$.—*Berzelius.*	3·11	5—5·5
$e^3)\mathrm{Si}^2 6\dot{\bar{\mathrm{H}}}$.—*Berzelius.* ${}^6+2\dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{Si}}$.—*Kersten.*	2·315	2

Species.	Atomic Constitution.	Specific Gravity.	Hardness.
Washingtonite. Ilmenite, pp. 381, 603	$2\underset{\cdot}{\mathrm{F}}{}^3\dot{\mathrm{T}}\mathrm{t}+\underline{\mathrm{F}}{}^3\dot{\mathrm{T}}\mathrm{t}$	4·963—5·016	5 75
Monazite, p. 422	$(\dot{\mathrm{C}}\mathrm{e}, \dot{\mathrm{T}}\mathrm{h})^3\dddot{\bar{\mathrm{P}}}$?—*Frankenheim.*		
Pitchblende, p. 426 . . .	$\dot{\mathrm{U}}\,\ddot{\bar{\mathrm{U}}}$.—*Rammelsberg.*	6·05—7·05	5·5
Johannite, p. 430 . . .	$\ddot{\bar{\mathrm{U}}}, \dot{\bar{\mathrm{H}}}, \dddot{\mathrm{S}}$.—*Frankenheim.*	3·19	2—2·5
Erinite of *Haidinger*, p. 509 .	$\mathrm{Cu}^{2\frac{1}{2}}\dot{\mathrm{A}}\mathrm{s}+\mathrm{Aq}$	4·043	4·75
Scorodite, p. 599	$\dot{\mathrm{F}}\mathrm{e}^2\dddot{\bar{\mathrm{A}}}\mathrm{s}+2\dddot{\bar{\mathrm{F}}}\mathrm{e}\dddot{\bar{\mathrm{A}}}\mathrm{s}+12\dot{\bar{\mathrm{H}}}$.—*Berzelius.*	3·1—3·2	3·5—4
Leuchtenbergite, 604 . . .	$6\dot{\mathrm{M}}\mathrm{g}\dddot{\bar{\mathrm{A}}}\mathrm{l}+7\dot{\mathrm{M}}\mathrm{g}^3\dddot{\mathrm{S}}\mathrm{i}^2+9\dot{\mathrm{M}}\mathrm{g}\dot{\bar{\mathrm{H}}}^2$	2·71	2·5
Arsenical Antimony, p. 606 . .	StAs³	6·2	2—4
Batrachite, p. 606 . . .	$\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{S}}\mathrm{i}+\left.\begin{matrix}\dot{\mathrm{M}}\mathrm{g}^3\\ \dot{\mathrm{F}}\mathrm{e}^3\end{matrix}\right\}\dddot{\mathrm{S}}\mathrm{i}$.—*Rammelsberg.*	3·038	5
Chronikrite, p. 608 . . .	$3(\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{C}}\mathrm{a})^3\dddot{\mathrm{S}}\mathrm{i}+\dddot{\bar{\mathrm{A}}}\mathrm{l}^2\dddot{\mathrm{S}}\mathrm{i}+6\dot{\bar{\mathrm{H}}}$.—*Kobell.*		2—4
Dermatine, p. 609 . . .	$\dot{\mathrm{M}}\mathrm{g}^2\dddot{\mathrm{S}}\mathrm{i}+4\dot{\bar{\mathrm{H}}}$.—*Von Kobell.*	2·136	2
Marceline, p. 609 . . .	$\dddot{\bar{\mathrm{M}}}\mathrm{n}^3\dddot{\mathrm{S}}\mathrm{i}$.—*Berzelius.*	3·8	Scratches glass.
Nontronite, p. 610 . . .	$\ddot{\bar{\mathrm{F}}}\mathrm{e}\dddot{\mathrm{S}}\mathrm{i}^2+6\dot{\bar{\mathrm{H}}}$		
Steinmannite, p. 611 . . .	$\acute{\mathrm{P}}\mathrm{b}^4\overset{\prime\prime\prime}{\bar{\mathrm{S}}}\mathrm{b}$.—*Frankenheim.*	6·83	2·5
Stilpnomelan, p. 611 . . .	$2\dot{\mathrm{F}}\mathrm{e}^3\dddot{\mathrm{S}}\mathrm{i}^2+\dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{S}}\mathrm{i}^2+6\dot{\bar{\mathrm{H}}}$.—*Rammelsberg.*	3·27—3·4	3—4
Sylvyne, p. 612	KChl²		
Pickeringite. Magnesia Alum, p. 616	$\dot{\mathrm{M}}\mathrm{g}\dddot{\mathrm{S}}+\dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{S}}^3+22\dot{\bar{\mathrm{H}}}$.—*Hayes.*	1·78—1·80	2—2·5
Monradite, p. 618 . . .	$4(\dot{\mathrm{M}}\mathrm{g}, \underline{\mathrm{F}})\mathrm{S}^2+\mathrm{Aq}$.—*Berzelius.*	3·27	Equal to Felspar.
Bromlite, p. 304	$4\mathrm{Br}\dot{\mathrm{C}}+4\mathrm{Cal}\dot{\mathrm{C}}+\mathrm{Mn}\dot{\mathrm{C}}$	3·718	2·25

$\text{Si}+2(\ddot{\text{A}}\text{l}, \text{Fe})\text{Si}$.—*Wagner.*	3·066	6·7
$\ddot{\text{A}}\text{l}+\dot{\text{R}}\dot{\text{H}}^3$.—*G. Rose.* $\ddot{\text{A}}\text{l}+\dot{\text{R}}\dot{\text{H}}$, or $[3(\dot{\text{R}}\ddot{\text{S}}\text{i}+\dot{\text{R}}^3$ $]+\ddot{\text{A}}\text{l}\dot{\text{H}}^3$.—*Rammelsberg*		
$+3\text{AlS}^6$,	2·633	
	3·75	6
al, Mg, N, K)S^3	2·67	6
S^4+16Aq	2·04	1·75
$+\dddot{\text{A}}\text{lS}+6\dot{\text{H}}$.—*Svanberg.*		
+N, Ca, Mg, F)S^2	3·03	Scratches glass.
$\dot{\text{S}}$	3·2—3·4	3·25
$)^3\ddot{\text{S}}\text{i}+3\ddot{\text{A}}\text{l}\ddot{\text{S}}\text{i}+7\dot{\text{H}}$.—*Ramm.*	2·35	5—5·5
$(\dddot{\text{P}}, \dddot{\text{A}}\text{s})+$ F, Cl).—*Frankenheim.*		
N)S^2+6Aq.—*Connell.*		
$\ddot{\text{S}}\text{i}^2+3\ddot{\text{A}}\text{l}\dddot{\text{S}}\text{i}^2+6\dot{\text{H}})+$ $\text{a}\left\{\begin{matrix}\text{Cl}\\ \text{Fl}\end{matrix}\right.+3\dot{\text{C}}\text{a}^3\,\dddot{\text{P}}$	2·10	6

DESCRIPTIVE MINERALOGY.

PART II.

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CLASS I.

EARTHY MINERALS.

This class includes those minerals which consist of one earth or more, united with definite proportions of water, and sometimes with common metallic oxides, as of iron and manganese, and rarely with an acid. These latter substances, however, are frequently to be regarded as mere mixtures, or accidental and variable constituents of the species described. We shall begin with silica in its purest form, as being the oldest and most abundant mineral, and as affording the most simple arrangement; and then proceed to such as, by the most authentic analyses, appear to consist chiefly of silica. Those of which alumina forms the greatest proportion succeed, as being the earth next in age and abundance. Magnesia follows; then such minerals as consist primarily or in part of zirconia, or glucina, or lastly of yttria and thorina.*

QUARTZ.

Quarz, W. and H. Rhombohedral Quartz, M. Hyatus Rhombohedrus, D.

Pure silica accidentally mixed with minute proportions of metallic oxides, — from whence the fine colors of this species are derived.

	Rock Crystal.		Amethyst.
Silica	99·375		97·50
with a trace of alumina and manganese.		Oxide of iron	0·50
		Alumina	0·25
		Ox. of manganese	25
	99·375 Bucholz.		98·50 Rose.

Sp. Gr. 2 6. H. = 7·0.

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* It is to be understood that nearly all the minerals included under this class, are those in which silica performs the part of an acid, and is combined in atomic proportions with several bases, as shown by the formulæ. It would have been more in accordance with

Pure silica, which thus constitutes all but a minute portion of rock crystal and amethyst, is composed of silicium and oxygen in the proportion of 48·05 parts of the former, and 51·95 of the latter. By some it is regarded as a protoxide, and by others as consisting of 1 atom silicium and 3 atoms oxygen. (See the table of atomic weights.)

Of quartz there are many varieties, most of which the older mineralogists described as distinct species. Some of these differ considerably in their external characters: others nearly agree: they are all sufficiently hard to scratch glass, and, when compact enough, they give fire with steel; they do not yield to the knife, and alone are infusible B B, by exposure to which the colored varieties generally lose their color; with carbonate of soda they fuse with effervescence into a transparent glass.

Quartz occurs massive and crystallized; also stalactitic, pseudomorphous, spongiform, granular, compact, &c. Its crystals possess double refraction with one positive axis, and have the property of polarizing the rays of light into a system of single rings, first observed by M. Arago.

CRYSTALLIZED QUARTZ. Berg-crystal, Gemeiner Quarz, W. Quarz Haylin,* H. There is no specific difference between common quartz and rock crystal. The latter term was formerly confined to the large transparent crystals of Madagascar, the Alps, &c.; but the small and even minute transparent crystals occurring in almost all metalliferous veins do not differ from rock crystal, either in chemical or external characters.

The common form of crystallized quartz is a six-sided prism terminated by six-sided pyramids (fig. 6); the two pyramids joined base to base (fig. 3) without an intervening prism are less frequent. The crystals may be cleaved, presenting brilliant surfaces, parallel to all the planes of the six-sided pyramid (fig. 3), which might therefore be considered as the primary form of quartz, but the obtuse rhomboid has been adopted as more simple: the connection between this rhomboid and the six-sided pyramids will be perceived by consulting figs. 1, 2, and 3. The angles of the primary rhomboid are 94° 15′ and 85° 45′, according to coinciding measurements by the reflecting goniometer, taken both on cleavages and natural planes. The cross fracture is often perfectly conchoidal. From two

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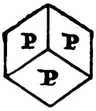
the purely chemical arrangement adopted in this work, had such combinations been placed under a distinct head; but as this would occasion a radical change in the author's plan, and almost entirely abolish the present class, I have concluded, with this explanation, not to alter the arrangement in the present edition. [AM. ED.]

[*] The meaning of the term Quartz is not known; Hyalin, from its vitreous aspect.

pieces rubbed together in the dark, a phosphorescent light is produced, and a faint empyreumatic odor is at the same time emitted.

1.



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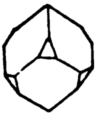

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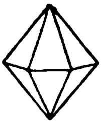

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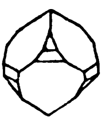

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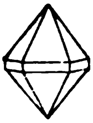

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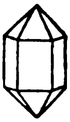

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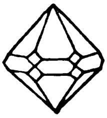

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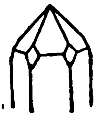

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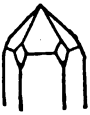

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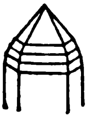

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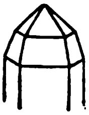

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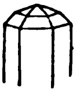
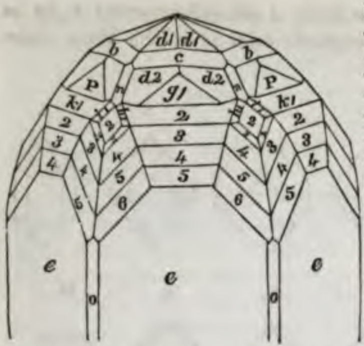


Fig. 1, the primary rhomboid. Fig. 2, the lateral angles replaced by triangular planes, which are complete in fig. 3, having converted the rhomboid into a dodecahedron with triangular planes. Fig. 4 shows the small triangular planes connected with four-sided planes, which are parallel with the axis of the crystal. Fig. 5, the four-sided plane complete. Fig. 6, the four-sided plane elongated, being the common crystal of quartz. Fig. 7 shows a rhombic plane on each of the lateral angles of the dodecahedron; this very rare form has been observed among the Bornholm diamonds. Fig. 8 exhibits an irregular four-sided plane on the upper left corner of each plane of the prism of a common crystal; if the crystal were drawn complete, the same plane would be shown on the lower right corner. Fig. 9. presents the same plane on the upper right corner, which frequently occurs: these planes are mostly seen in combination with the rhombic planes of fig. 7. Fig. 10 shows the replacement of the edges between the lateral and terminal planes, by four planes: these mostly occur in combinations of figs. 8 and 9. Fig. 11 presents one of the four planes increased, tending to a very acute six-sided pyramid capped by the common pyramid. Fig. 12 shows the replacement of the apex of the common pyramid by six planes, forming a very obtuse pyramid.



P on P	94°	15′	
—— *g* 1	133	48	H.
P on *k* 1 or *g* 1 on *g* 2	160	5	
—— *k* 2 ——— *g* 3	156	30	
—— *k* 3 ——— *g* 4	152	20	
—— *k* 4 ——— *g* 5	149	20	
P or *g* 1 on *e*	141	40	H.
e on *e*	120		
P on *i* 1 or *g* 1 on *h* 1	165		*c.g.*
P or *g* 1 on *i* 2	151	20	
P on *h* 3 or *g* 1 on *i* 4	151	16	
—— *h* 4 ——— *i* 5	148	50	
—— *h* 5 ——— *i* 6	142	20	
b on *b*	125	10	
P on *b* or *g* 1 on *c*	160	15	
d 2 on *d* 2	179	15	
d 2 on *g* 1	179	30	

The planes *b b* tend to an obtuse rhomboid, or, in connection with *c*, to an obtuse six-sided prism.

The planes *k* 1 to 4 to acute rhomboids, or, in connection with *g* 2 to 5, to six-sided pyramids more acute than the common one.

The planes *h* 1 to 5 and *i* 1 to 6 occasionally, though rarely, occur on the same crystal.

The planes *n* and *o* are always convex: *d d* are always minute and rough.

The planes *o o* sometimes replace only the alternate edges of the prism.

The finest specimens of crystallized quartz, or rock crystal, occur in Savoy, Dauphiné, and elsewhere among the Alps, forming drusy cavities in mica slate; gigantic crystals have been brought from Madagascar and the Brazils; while the smaller, but often most transparent and perfect, are of frequent occurrence in metalliferous veins. Beautifully limpid crystals occur imbedded in primitive marble at Carrara, and very brilliant specimens at Cape Diamond, near Quebec. The species quartz does not by any means abound in varieties of crystalline form, and yet, owing to the disproportionate size of the faces, its crystals offer considerable diversity of appearance. Rock crystals sometimes present beautiful iridescences, both superficially and internally; when external, it is supposed to arise from the deposit of some metallic oxide, probably of iron; when internal, it is the refraction of light in consequence of fissures in the crystal; and it will often be found that these fissures are straight, and parallel with one or other of the planes of the pyramid. This appearance may be produced by plunging a heated crystal into cold water; the laminæ then partially separate parallel to the natural joints. Another interesting peculiarity of quartz is its frequent occurrence in *pseudomorphous* crystals; at Schneeburg, in Saxony, it assumes the forms of various calc-spars; at Beeralstone, in Devonshire, those of certain fluors; at Montmartre, near Paris, that of lenticular gypsum, &c. (See table, p. lxxxii. of the Introduction.)

In Cornwall rock crystals are abundant; but the clearest as well as the largest specimens have hitherto been obtained from the slate quarries of Delabole and the vicinity of Tintagel. They were esteemed and used for personal ornaments in the time of Queen Elizabeth; and Carew, in his

Survey of Cornwall (1602), thus notices them: "In blacknesse and in hardnesse they come behind the true ones; yet I have knowne some of them set on so good a foile, as at first sight they might appose a not unskilfull lapidarie." (De la Beche, *Report on Cornwall, Devon*, &c., p. 497.)

In the United States the localities of this species are numerous, but New York has furnished the most beautiful and interesting crystalline forms, particularly Herkimer County. These have been described with great particularity, and numerous figures of them given, in the elaborate report of Professor Beck on the Mineralogy of New York, recently published, to which the reader is referred. They occur in the cavities of calciferous sandstone, and not unfrequently contain cavities themselves, which are occupied by small concretions of anthracite, and also by a bituminous fluid and drops of limpid water. These are sometimes contained in the same cavity, and their presence is rendered the more obvious by small bubbles of air, which move to and fro, as in a spirit level, by alternately changing the position of the crystal.

Crystals of quartz are occasionally found *enclosing* foreign crystallized substances—as schorl, asbestus, actynolite, crystallized titanite, and specular oxide of iron. The most remarkable specimen containing titanium which has hitherto been found in the United States, was discovered in New Hampshire, in a detached mass, and is now in the possession of Prof. Hubbard, of Dartmouth College.* Crystals scarcely less remarkable, but of a smoky color or topaz yellow (Caringorm), and enclosing long, slender, prismatic crystals of schorl, have been found in Nova Scotia. One of this character, in the collection of the American editor, weighs 90 pounds.

The crystals from St. Lawrence County, N. Y., as well as some of those from Herkimer, present the common pyramids, without the intervention of the prism, forming the *dodécaèdra* of Haüy, the derivation of which from the primary, is shown in fig. 2. In a few instances, individuals from the former locality present the primary rhomboid almost perfect, or having its lateral angles replaced by tangent planes *r*, and also by the small triangular planes *z* resting on the upper edges of the rhomboid, as seen in fig. 13, and also in small fig. 4. A remarkable specimen of this form, upwards of one inch in length, was in the collection of Mr. Lukins of Philadelphia. It came from Lake George. A form yet more rare from this locality, the *unibibinaire* of Haüy, was described several years since by Dr. Troost, in vol. ii. *Jour. Acad. Nat. Sci.*, and is now figured by Prof. Beck as having the alternate solid angles of the prism replaced by rhomboidal faces, as in the

Fig. 13.

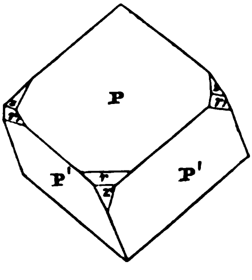
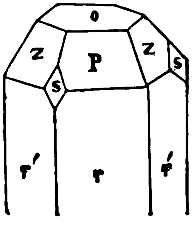


Fig. 14.



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* Since discovered in place by Dr. C. T. Jackson in the lime quarries of Orford and Lyme, N. H. See his Report on the Geological Survey of the State.

rhombifère of Haüy. But a single example of this combination has been observed by them. (See fig. 14.) P, and the adjoining planes z, incline upon *o* at an angle of 128° 20′, P or *z* on *s*, 151° 7′. Shepard (*Mineralogy*, p.

Fig 15.

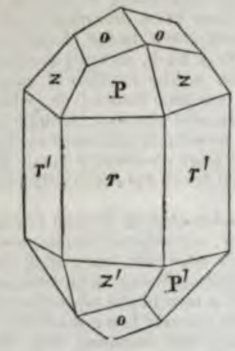


Fig. 16.

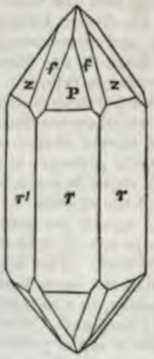


Fig. 17.

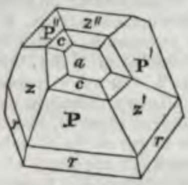


Fig. 18.

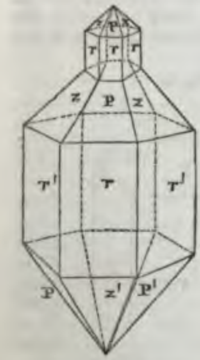


Fig. 19.

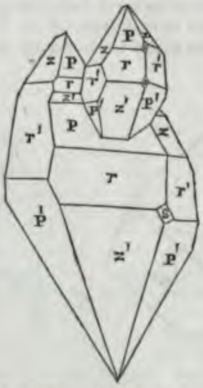
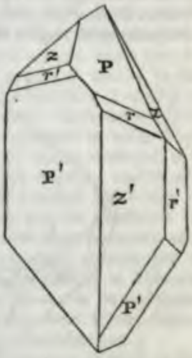


Fig. 20.



142) has cited American localities of one or two rare forms to which distinctive names have been given by Haüy, two of which are here represented in figs. 15 and 16, the latter having the edges of the pyramids

truncated (*émarginé* of Haüy). P on *o* 160° 15′, *o* on *o* 125° 10′: corresponding to P on *b*, or *g* 1 on *c*, and *b* on *b* of the large figure by Phillips. P on *f* or *z* on *f* 141° 40′. Fig. 17 is a rare example from Middleville, Herkimer County, N. Y., cited by Professors Beck and Shepard; P on *a* 145° 22′, *c* on *a* 159° 50′, *c* on P 165° 30′, *z″* on *a* 111° 15′, *z* on *a* 137° 51′, *z* on *c* 145° 30′, *a* on *c* 175° 30′.[*] Examples of the form of fig. 18 have been found at Chesterfield, Mass.; they have also been brought from Nova Scotia and New Holland, in both instances attached to masses of trap rock. Perfectly transparent crystals of the dodecahedral form have also been found in Nova Scotia. Many of the specimens from Herkimer, N. Y., offer beautiful examples of the postnatal compositions mentioned in the Introduction, p. liii., and their appearance is sometimes most unique and fantastical. Interesting examples are presented in figs. 18 and 19, in which it will be observed that the small crystals are united to the larger ones by the contact of similar planes, and that the similar planes of both are parallel with each other. Rarely has a small crystal deeply penetrated the side of a larger one, and may be removed, leaving a perfect impression of its form. Fig. 20 represents a form but rarely found at Middleville, in which the planes P′ and *z′* are unduly extended, thus nearly approximating to the *prismé sphalloïde* as figured by Haüy.[†] P on *r* 141° 40′, P on *z* 138° 48′, *r* on *z* 141° 40′, *r* on *s* 142°, P or *z* on *s* 151° 7′.

The following sub-species have been distinguished:

1. Avanturine. Quarz hyalin avanturine, H. A variety of quartz rock, including small laminæ of mica, which, when polished, presents a shining spangle-like appearance. The most common color of the base is brown, or reddish brown, enclosing spangles of a gold color, as in the variety from Cape de Gatte in Spain; occasionally it exhibits a fine green tint.

2. Prase. Quarz hyalin vert-obscur, H. This variety possesses a dark leek-green color (whence its name from the Greek). It only occurs massive, with amphibole, principally in the iron mines of Breitenbrunn, in Saxony. In the U. S. it is abundant at Cumberland, R. I., and encloses acicular and asbestiform actynolite, to which it appears to owe its fine color.

3. Milk Quartz. Quarz hyalin laiteux, H., and Rose Quartz. Quarz hyalin Rose, H. Occur massive, and are only distinguished by their color; the former, as its name denotes, presents a milky aspect, while the latter has frequently a fine rose-red tint, which is supposed to be derived from a minute admixture of manganese. It occurs in granite at Rabenstein in Bavaria, at Abo in Finland, and has numerous localities in the United States.

4. Violet Quartz. Amethyst. Quarz hyalin violet, H. Amethyst chiefly differs from common quartz in its color, which is purplish violet, supposed to be derived from a minute propor-

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[*] Several of the measurements by Haüy do not exactly correspond with those of similar planes by Phillips, but the latter are to be regarded as the most accurate, having been obtained by means of the reflecting goniometer. [Am. Ed.]

[†] Fig. 18 is given on the authority of Prof. Beck. Figs. 19 and 20 are drawn from crystals in the possession of the editor. The former is about six inches in length.

tion of iron and manganese, which it contains; it becomes white and opalescent by long exposure to heat. The best amethysts are brought from Cambay in India, from Siberia, Ceylon, and Persia, where they are found both lining the cavities of geodes, and in rolled masses. Of inferior transparency and hue, they occur in Sweden, the Hartz, Bohemia, Transylvania, in agate balls at Oberstein in Germany, in large crystalline groups near Cork, and in Brazil. Amethyst is a very common mineral in the trap rocks of Nova Scotia, as at Partridge Island and Cape Blomidon, where it frequently forms geodes of projecting crystals, over which are implanted very perfect crystals of heulandite and apophyllite. The finest purple variety is found on Digby Neck in rolled masses on the shore of St. Mary's Bay. In the United States, the trap rocks of Connecticut and Massachusetts also furnish specimens. At Bristol, R. I., pale colored crystals of amethyst are found in decomposing granite, and contain cavities partially filled with a fluid substance. Fine crystals have also been found in Delaware County, Pa. But amethyst, in crystals of large size and deep color, is comparatively rare in the United States. A crystal in the cabinet of Mr. Allen contained four cavities partially filled with a fluid resembling naphtha, which, on being heated to 83°, would entirely fill the cavities, and, on cooling, reappear, accompanied by apparent ebullition.

5. Yellow Quartz. Quarz hyalin jaune, H. Is of various shades of yellow, and nearly transparent. Splendid specimens have been found at Cairngorum, in Inverness-shire, whence the trivial name frequently applied by lapidaries to this variety.

6. Brown Quartz. Quarz hyalin enfumé, H. Closely allied to the last, but less transparent, and more common.

7. Ferruginous Quartz. Eisenkiesel, W. Quarz hyalin rubiginex, H. Iron flint, J. This variety presents several shades of yellow and red, and occurs both massive and crystallized. It is opake, gives sparks with steel, and consists chiefly of silica, with about 5 per cent. of iron. Eisenkiesel is found in Bohemia, in iron-stone veins in the Hartz, and at Altenberg in Upper Saxony.

8. Radiated Quartz occurs in crystals which are closely aggregated, and which radiate from a point.

9. Fibrous Quartz is produced when the composition presents thin columnar particles. The cat's-eye is a variety of this, interspersed with thin filaments of asbestus, which, when the stone is cut *en cabochon*, presents a peculiar opalescent, or (as the French term it) chatoyant streak of light. It is usually of a greyish or greenish color, but often brown and red; it con-

tains small portions of alumina and lime, derived from the asbestus which traverses its mass; is generally translucent, and is frequently employed as an ornamental stone. Its principal localities are Ceylon and the Malabar coast.

10. Spongiform Quartz. Schwimmstein, W. Float-stone, J. The *quartz nectique* of Haüy is described as occurring in beds of flint in chalk, at St. Ouen near Paris. It presents a spongy or porous appearance; consists of numerous minute white or greyish-white crystals; scratches glass; and, as its name indicates, possesses the property of swimming on water, at least until the air contained in its numerous cavities is displaced. It has also been observed under different forms in some of the Cornish mines. It consists, according to Vauquelin, of 98 silica, and 2 carbonate of lime.

In the massive state, quartz is a most abundant mineral, forming extensive veins in primitive and transition rocks, and being consequently diffused over almost every quarter of the globe. White silica sandstone, or granular quartz, is almost pure silica, or contains only minute portions of foreign matter united with it as a mechanical admixture. Near Villa Ricca in Brazil, a variety of sandstone occurs in thin strata, which is remarkable for its flexibility, a property apparently arising from small scales of mica disposed throughout its mass. The minute particles of pure white sand are likewise quartz in a state of disintegration, resulting from the destruction of this species. Such are the sands of the coast of Norfolk, and of Alum Bay in the Isle of Wight, so largely used in the making of glass: a somewhat similar sand is found in the caverns of Reigate in Surrey.

11. Flint consists of about 98 per cent. of silica, with minute proportions of oxide of iron, lime, alumina, and water. — *Klaproth.* Specific gravity about 2·59. It is of various shades of grey, yellow, and black. It is somewhat harder than common quartz, which it scratches: is rarely laminated, and therefore may be broken with nearly equal ease in every direction: is brittle when first taken from the native bed, but becomes harder by exposure; has a flat conchoidal fracture, and feeble lustre: thin fragments of the black varieties are very translucent and sharp. It is infusible, but whitens and becomes opake when exposed to heat.

In the chalk formation it occurs in regular beds, and consists either of nodules or flat tabular masses; the cliffs near Dover present fine examples of this. Flint is also abundant in alluvial deposits in the neighborhood of chalk, as in France and the north of Ireland. It is often found enclosing sponges, alcyonia, echinites, and other fossil remains. By exposure to the action of air and water it becomes yellow, and is then termed *ferruginous flint;* such for the most part are the flints of our gravel beds, which have been rounded by attrition.

12. CALCEDONY[*] presents various shades of white, grey, yellow, brown, green, and blue, — the color for the most part being uniform. It occurs massive: forming veins; in nodules; and also botryoidal and stalactitic; but never crystallized. It is commonly semi-transparent; has an even or very flat conchoidal fracture; is harder than flint, and is infusible; consists of silica 84·0, alumina 16, by the analysis of Bergman. Specific Gravity 2·6.

Splendid stalactitic specimens of this mineral were at one time found in Trevascus mine in Cornwall; Iceland and the Faroe Isles are now, however, its best known localities. It also occurs in Ceylon, in several parts of India, in Siberia, in Carinthia, Hungary, and many of the Hebrides. Pednandræ mine in Cornwall has yielded it of a smalt-blue color; and a variety presenting the form of hexahedral crystals, which, however, are certainly pseudomorphous, has been brought from Tresztyan in Transylvania.

The most splendid masses of calcedony hitherto brought to the United States are those collected in great abundance on the shores of Desolation Island in the South Indian Ocean by the whale fishermen. They are hollow, consisting of thin crusts, which are oftentimes pure white and nearly transparent, and have their interior surfaces covered with botryoidal projections of the same color and appearance.

The following are considered varieties of calcedony.

13. ONYX.[†] Consists of alternate layers of brown and opake white calcedony, and is that variety specially used in the formation of cameos.

14. PLASMA[‡] is grass-green and semi-transparent, with a glistening lustre. It occurs principally in India and China, and is brought to this country in the shape of beads and other ornaments; occasional specimens are found among the ruins of Rome.

15. HELIOTROPE or BLOODSTONE is usually deep green and translucent, with yellow or blood-red spots interspersed through

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[*] So named from the town of Calcedon in Upper Asia, where it was collected by the ancients.

[†] According to Brongniart, "*onyx* veut-dire *ongle*" (the nail); inferring that this stone received its name from the two colors sometimes observable on the human nail.

[‡] Plasma, Greek, engraving; the stone having been used by the ancients for that purpose.

the mass. Its color is supposed to be derived from green earth. It is found in Siberia, Iceland, in the Isle of Rum, and elsewhere. Well-characterized heliotrope, consisting of a ground of green calcedony abundantly suffused with blood-red dots and delicate thread-like ramifications of jasper, has been obtained among the trap rocks of Nova Scotia. Among lapidaries it is in considerable request.

16. **Chrysoprase** is of an apple-green color; translucent; massive; internally somewhat glimmering, or not quite dull; and its fracture is even, rarely approaching the conchoidal; B B it loses its color, becomes opake, but is infusible without addition. According to Klaproth it consists of silica 96·16, oxide of nickel 1·0, and minute portions of lime, magnesia, alumina, and oxide of iron, — its color being attributed to the nickel. It has been found extensively at Kosemutz in Silesia, in veins traversing serpentine, and accompanied by calcedony, opal, quartz, and pimelite. It is much prized by jewellers, and is usually cut into a convex form.

17. **Cacholong** is opake, of a milk or yellowish-white color; externally dull, but internally of a somewhat pearly lustre; it sometimes disintegrates by exposure, when it adheres to the tongue; and B B is infusible. Its specific gravity is about 2·2, and it appears to be closely allied to hydrophane.

It occurs in loose masses on the borders of the river Cach,* in Bucharia; also with calcedony in the trap rocks of Iceland; in the Faroe Islands; in Nova Scotia, and in Greenland.

18. **Carnelian.**† Karneol, W. Quartz agathe cornaline, H. Carnelian and agate do not materially differ. The former is principally from Arabia, India, and Surinam, where it is found in nodules of a dark grey color. These are first exposed to the sun for some weeks, and then placed in earthen pots and subjected to heat, which gives them those hues which constitute their value in jewelry.

19. **Agate** is an impure variety of calcedony, of frequent occurrence in the vesicular cavities of amygdaloidal rocks. It presents the most brilliant and the most varied colors, and, from its hardness and compact structure, being capable of receiving a high polish, occupies a distinguished position in most collections. The parallel lines which some agates exhibit, when cut and polished, much resemble those of a *fortification*. In others the colors alternate, as in certain *ribbons*. A variety from Saxony presents a *brecciated* structure; and so forth. When

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* Hence its name of Cacholong.

† From the resemblance of its color to that of flesh.

translucent, and containing appearances of aborization, or vegetable filaments, but which are ascribed to the infiltration of iron or manganese, it is termed *Mocha-stone;* this is principally brought from Arabia. *Moss agate* is calcedony containing delicate vegetable ramifications of different shades, and occasionally traversed by irregular veins of red jasper.

The most beautiful agates are found in the trap rocks of Oberstein; some are hollow, and are lined with crystals of amethyst; others also include harmotome. Agate is also found in Saxony, Bohemia, Silesia, Italy, Siberia, and India. The Hill of Kinnoull and the Isle of Skye are well-known Scotch localities. Specimens recently brought from Nova Scotia will vie in beauty with any from the most noted European localities. A collection was also brought, a few years since, from New Holland, which comprised rare and beautiful forms of moss agate, with botryoidal green and white calcedony. Agate is used both as an ornamental stone, and for cups and mortars by the chemist. The facility with which certain of its lines imbibe moisture enables the lapidary, by boiling it first in oil and then in sulphuric acid, to give it much the resemblance of the onyx.

20. **Common Jasper**, in a chemical point of view, only differs from agate in containing a larger portion of iron; mineralogically, it is for the most part readily distinguished by its opacity. Its prevalent colors are yellow, brown, and red of various shades, and sometimes green; occasionally intermixed, or in spots and irregular veins. It has often a resinous lustre, but is sometimes dull; its fragments are rarely translucent on the edges; is hard, and frequently brittle, and does not fuse B B. It occurs in many parts of the Continent, in veins and beds both in primitive and secondary mountains; also in Cornwall, in the Pentland and Moorfoot Hills, and in other parts of Scotland; also in Nova Scotia.

21 **Striped Jasper**, or **Ribbon Jasper**, presents green, yellow, and red colors, of various shades, the most beautiful variety being composed of equal and parallel layers of these colors. It occurs principally in the Ural Mountains of Siberia, in Saxony, and in Devonshire. Variously colored varieties are found in Nova Scotia.

22. **Egyptian Jasper**, or **Egyptian Pebble**, occurs in roundish masses which are externally rough, and generally of a brown color. Internally it exhibits a lighter hue, which sometimes approaches to that of cream, around which are disposed irregular zones or bands of brown, sometimes intermixed with nearly black spots, and also with dentritic appearances. It is

found, according to Dr. Clarke, in abundance, together with masses and detached fragments of petrified wood, scattered over the surface of the sandy desert eastward of Grand Cairo, even to the borders of the Red Sea.

23. **Porcelain Jasper**, or **Porcellanite**, is also by some mineralogists considered a variety of this species; but it is merely clay indurated by heat. It is compact, massive, and opake; presents sometimes a slaty structure, with a vitreous, uneven, conchoidal fracture, and has either a bluish grey, or a light fawn color. It melts B B into a semi-transparent enamel, and is therefore quite distinct from any of the jaspers. It occurs principally in the neighborhood of coal seams which have been in a state of combustion, and is abundant around Carlsbad in Bohemia.

24. **Hornstone.** A green-colored soft hornstone, used for the setting of lancets, yielded to Faraday, silica 71·3, alumina 15·3, protoxide of iron 9·3, and a trace of lime.

This substance occurs massive, in nodules, and pseudomorphous. The massive has a splintery or somewhat conchoidal fracture, and is translucent or opake; is dull, or has a glimmering lustre; is scarcely so hard as quartz, and is infusible. Its general color is grey, which is tinged blue, green, brown, red, or yellow. In appearance it closely resembles compact felspar: hornstone, however, is infusible; felspar is fusible. Hornstone is found in round masses in limestone in the Tyrol, forming veins in Hungary and Sweden, and presenting remarkable pseudomorphous crystallizations in Saxony and Bohemia. It is by most mineralogists classed with flint.

The United States can scarcely be said to furnish their proportion of localities of the several varieties last described, probably from the rare occurrence of trap rocks, in which they most abound. A beautiful green chrysoprase is found in serpentine at New Fane, Vt.; prase penetrated by actynolite at Cumberland, R. I.; rose quartz at Acworth, N. H., Paris and Topsham, Me., Southbury, Ct., Williamsburg and Chesterfield, Mass. Carnelian and agate are rarely found in the trap rocks of Connecticut and Massachusetts, but a deep red jasper is abundant at Saugus, and a yellow variety, with calcedony, is found at Chester, Mass.; hornstone, in rolled masses, is not uncommon; calcedony, common and onyx agate, with red jasper, occur plentifully along the shores of St. Mary's River and Lake Superior, loose and imbedded in amygdaloid. Hollow globular masses of reddish brown and yellow botryoidal calcedony occur at Tampa Bay, Florida. A very beautiful ribbon and agate jasper has been discovered by Dr. Jackson, near Machias, Me., where it is obtained in huge sheets and is wrought for ornamental purposes. The trap and basalitic rocks west of the Rocky Mountains, which have been recently explored by Dr. Parker, abound with most of the varieties above enumerated, particularly jasper, agate, and carnelian; and they are associated with the various zeolite minerals so common to these rocks, but which, we regret to say, are but incidentally alluded to in his journal.

25. **Kilpatrick Quartz.** Dr. Thomson has given this name to a variety of this species which is found in the trap rocks of Kilpatrick Hills, in the vicinity of Glasgow. Its principal peculiarity is that it occurs in small globular masses, sometimes in perfect spheres, "consisting of an aggregation of crystals, the forms of which cannot be made out; but the exterior termination of each, when examined under the microscope, appears to be a four-sided pyramid. So that each of the spheres is studded with small microscopic four-sided pyramids. It contains 3 per cent. of water, with a trace of sulphuric acid, and is rather lighter than common quartz. It is white and translucent." (*Outlines of Mineralogy*, &c., vol. i., p. 66.)

In Nova Scotia the same variety is found in cavities of the amygdaloid, sometimes lying loose from the rock, and showing but a minute point by which the sphere was once attached to it, while in the process of forming. It consists of radiating prisms, proceeding from a common centre, and terminating in pyramids externally, but of the usual form.

OPAL.

Opal, W. Quarz Resinite, H. Silex Opale, Bt. Uncleavable Quartz, M. Hyalus Opalinus, D.

Opal, like quartz, consists chiefly of silica and water; but analysis generally indicates a greater quantity of the latter than in quartz. Its occasional resinous lustre is probably the origin of Haüy's appellation. None of its varieties are sufficiently hard to give fire with steel. Specific gravity 2·09 to 2·35.

1. **Precious Opal. Noble Opal.** Edler Opal, W. Quarz resinite opalin, H. This beautiful mineral is of a white, bluish, or yellowish-white color, and, when viewed by transmitted light, is yellow. It exhibits brilliant and changeable reflections of green, blue, yellow, and red. This play of colors has not been satisfactorily accounted for; Sir D. Brewster supposes it to be owing to the refraction and reflection of light in certain openings in the interior of the mass, which are not fissures, but possess a uniform shape. It is translucent; fracture conchoidal, with a vitreous or resinous lustre; easily

broken, but scratches glass. B B it decrepitates, and loses its colors. The Hungarian consists, according to Klaproth, of 90 silica and 10 water: this water, however, is believed (in common with the water found in some other silicious minerals) to be hygrometric, and therefore to vary with the state of the atmosphere. It occurs, accompanied by common opal, imbedded in porphyry, at Czervenitza in Hungary; in trap rocks in the Faroe Islands; at Freyburg, in Saxony, and at Gracios a Dios, in the province of Honduras, in America, whence it has been brought in specimens of considerable size and of great splendor, the color being milk-white with a faint shade of blue. Small fragments of what appear to be trachite were attached to the specimens which have been brought from this place into the United States.

2. Fire Opal. Quarz resinite girasol, H. Silex girasol, Bt. Is found with the noble opal in Hungary, but is much scarcer. It differs from the precious in possessing only bright hyacinth-red and yellow tints when turned towards the light. It occurs principally at Zimapan in Mexico, in the Faroe Islands, and (accompanying the opal just described) from Gracios a Dios in Honduras. Also in Guatemala. "Humboldt first made known the rich repository of this mineral in Mexico, and one of the most magnificent specimens ever obtained was deposited by him in the Royal Mineralogical Cabinet at Berlin. It occurs in trachytic porphyry." (*Feuchtwanger on Gems.*)

3. Common Opal. Gemeiner Opal, W. Quarz resinite commun, H. Silex resinite, Bt. Presents various shades of white, green, yellow, and red, but is entirely devoid of the play of colors peculiar to noble opal. In hardness, translucency, fracture, and specific gravity, it corresponds; and its constituents are, 92·0 silica, 7·75 water, and 0·25 oxide of iron. It occurs abundantly at Telkobanya and elsewhere in Hungary, forming short irregular beds which traverse porphyry; in Faroe occupying the cavities of amygdaloidal rocks; in Ireland, at the Giant's Causeway; and in many parts of the Hebrides.

4. Semi-Opal. Halb-Opal, W. Quarz resinite hydrophane, H.? Differs from the last in being more opake: the translucency, however, of some varieties is increased by immersion in water, particularly when in thin fragments. It occurs of various shades of white, grey, yellow, brown, and green. When compact, the fracture is flat conchoidal. According to Klaproth, it consists of 85·0 silica, 1·0 carbon, 1·75 oxide of iron, 8 ammoniacal water, and a small portion of bitumen. It

is found in amygdaloid in the Faroe Isles, Iceland, &c. associated with common opal; also near Frankfort, in some of the metalliferous veins of Cornwall, and in the trap of Nova Scotia.

5. Wood-Opal. Holz-opal, W. Quarz resinite xyloide, H. This variety is remarkable for its ligneous appearance. It presents several tints of white, grey, brown, and black; and in fracture, translucency, and lustre, does not materially differ from semi-opal, although somewhat harder. It occurs occasionally, forming large trees, in the pumice conglomerates of Neusohl and Kremnitz in Hungary; in trap rocks in Transylvania and the Faroe Islands; and in Van Diemen's Land.

6. Ferruginous Opal. Opal-jasper, W. Jaspe-opal, Br. Jasper-opal, J. The ferruginous is distinguished from common opal by its colors, which are deep shades of red, yellow, and grey; and by being opake, or only feebly translucent on the edges. Its fracture is flat conchoidal. B B it does not become white. A variety from Telkobanya yielded to Klaproth silica 43·05, oxide of iron 47·0, water 7·5. It occurs in porphyry near Telkobanya and Tokay in Hungary; in the Saxon Erzebirge; at Dominica; and in St. Helena.

7. Hydrophane. Quarz resinite hydrophane, H. A variety of opal devoid of transparency, but assuming it when immersed in water or any other transparent fluid (whence its name, from the Greek); emitting at the same time numerous globules of air, and becoming considerably heavier. It adheres to the tongue, and consists, according to Klaproth, of 93·1 silica, 1·6 alumina, 5·0 water and inflammable matter. It occurs in Hungary, in Bucharia, and at the Giant's Causeway, in small masses resembling mountain cork, which are quite opake until immersed in water, when they dilate and become translucent.

8. Menilite. Quarz resinite subluisant, brunatre, H. Menilite is a variety of semi-opal, occurring in compact reniform masses of a brown color; structure slaty, somewhat translucent, and found in beds of adhesive slate at Menil-montant, near Paris. From the resemblance of its darker varieties to pitch, it is sometimes called the *pitchstone of Menil montant.* It consists, according to Klaproth, of 85·5 silica, 1 alumina, 11 water and inflammable matter, with small proportions of lime and oxide of iron.

9. Hyalite.* Muller's Glass. Quarz hyalin concretionné, H. It occurs in white and transparent botryoidal masses, or in stalactites; has a vitreous lustre, is brittle, but is

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* From the Greek, in allusion to its glassy appearance.

as hard as quartz. Specific gravity about 2·4; B B it is infusible by itself, and consists, according to Bucholz, of silica 92, water 6·3, with a trace of alumina, or nearly 8 atoms silica to 1 atom water. This singular mineral is chiefly found investing or lining the cavities of trap or basaltic rocks. It occurs in amygdaloid near Frankfort-on-the-Maine, at Schemnitz in Hungary, and imbedded in clinkstone at Waltsch and other places in Bohemia. In the United States a mineral which resembles hyalite, and is regarded by some as fused quartz, is found at several places in St. Lawrence County, N. Y. Many of the rounded masses which occur with phosphate of lime, &c., at Hammond, have the characteristic appearance of the Bohemian hyalite. In Putnam County, N. Y., hyalite of a light blue color is found in the coatings on granite at the Phillips ore bed, associated with green malachite.

10. **Silicious Sinter.** Kieselsinter, W. Quarz agathe concretionné thermogéne, H. Consists of silica 98·0, alumina 1·5, iron 0·5 — *Klaproth.* Specific gravity about 1·8. The common colors of this mineral are white, greyish white, and yellow. It is light, brittle, dull, commonly porous, with a fibrous texture, although sometimes sufficiently compact to admit of a conchoidal fracture; lustre pearly. *Per se*, infusible B B. It occurs abundantly around, and is deposited by, the hot springs of Iceland, the Isles of Ischia, St. Michael, &c. It is sometimes in stalactitical shapes, the surfaces of which are studded with minute pyramids of quartz crystals. The variety from St. Michael, named Michaelite by Dr. J. W. Webster, is, according to his analysis, a pure hydrated silica. It is found with the other varieties, lining cavities, and in masses composed of long and delicate fibres, which cross and interlace each other, so as to form a beautiful network. Its color is snow-white, and sometimes of a beautiful amethystine tint. Specific gravity 1·88. (See Dr. Webster's interesting account of the Azores.) Specimens from the craters of Iceland and Teneriffe, analyzed by Dr. Kane (*Elements of Chemistry*, p. 526), show that these light and spongy sinters are truly definite compounds of silica and water, answering to the formula 2 Si +Aq.

A variety of this is the *pearl sinter* or *fiorite*, which occurs in stalactitical, cylindrical, botryoidal, and globular masses, of a white, yellowish white, or greyish color; externally it is smooth and shining, internally glistening with a pearly lustre; fracture flat conchoidal; translucent on the edges; not so hard as quartz, and infusible B B without addition. It consists of

96 silica, 2 alumina, and 2 lime. It occurs in volcanic tufa and pumice, in the Vicentine, the Florentine dominions, and in other volcanic districts of Italy.

KARPHOLITE.

Strohstein, W. Carpholite, N. Vulcanus Stramineus, D.

Silica 36·15, alumina 28·67, protoxide of manganese 19·16, protoxide of iron 2·29, lime 0·27, fluoric acid 1·47, water 10·78. — *Stromeyer.*

The lime and fluoric acid being regarded as accidental, its composition is thus stated by Dr. Thomson: 7 atoms silicate of alumina, 3 atoms sesquisilicate of manganese and iron, 6 atoms water; or, as expressed by the formula, $7\ AlS+3\ (\frac{17}{19}\ \underline{Mn}+\frac{2}{19}\ \underline{F})\ S^{1\frac{1}{2}}+6\ Aq$.

Sp. Gr. 2·935. H. = 5.

The color of this mineral is generally wax or straw-yellow (hence its name from the Greek). It occurs in tufts of minute, fibrous, imperfectly-formed crystals; also massive, with a fibrous and frequently radiated structure, which is rather incoherent; and in an earthy state, probably from disintegration; opake; with a silky lustre; and very brittle. B B on charcoal it intumesces, whitens, and fuses slowly into a brown opake glass; with borax it forms a transparent glass, which in the outer flame presents the amethystine tinge of manganese, and in the reducing flame becomes green.

It is found disposed on granite, with fluor and quartz, in the tin mines of Schlackenwald, in Bohemia.

ALUMOCALCITE.

Leonhard.

Silica 86·60, alumina 2·25, lime 6·25, water 4·0. — *Kersten.*

Specific Gravity 2·174. May be crushed between the fingers. *Color* milk-white, inclining to blue. *Streak* the same. *Fracture* conchoidal. Adheres strongly to the moistened lip. Yields water in the glass tube. Becomes opake and grey colored when exposed to heat in the platina forceps. With borax forms a colorless glass. In salt of phosphorus is soluble, with the exception of a silica skeleton. In concentrated muriatic acid it forms a transparent jelly.

This substance occurs in the clefts of ironstone veins at Eybenstock in the Erzgebirge. Breithaupt separated it from opal, with which it had previously been confounded; and to him we are indebted for the above description.

GARNET.*

Dodecahedral Garnet, M. Jam. Carbunculus Dodecahedrus, D.

Under this term are included several substances, consisting principally of the same elements, but united in variable proportions, as the silicates of alumina, lime, iron, and manganese, isomorphic bodies which have the property of replacing each other without changing the crystalline form, so that different formulæ must be employed in expressing their atomic proportions. Sp. Gr. 3·5 to 4·3. H. = 6·5 to 7·5. Dr. Thomson has attempted to show that the species garnet is a mixture, in various proportions, of the three different silicates which compose the varieties grossularite, common garnet, and colophonite, and are sometimes united with silicate of manganese; but to adopt this view we must exclude pyrope, of which chromic acid forms an essential constituent. More knowledge is needed in relation to this interesting class of minerals. It is sufficient to say that they all agree so far in their external characters as to present, under different modifications, the same primary form, a rhombic dodecahedron. As they are made into distinct species by some authors, the formulæ have generally been added.

1. Almandine. Precious Garnet. Edler Granat, W. Grenat, H. Grenat noble, Br. Bt. Combination of 1 atom of silicate of protoxide of iron, 1 atom of silicate of alumina. Formula: $\text{AlS}+\underline{\text{F}}\text{S}$.

	Bohemia.	New York.	Engso.
Silica	36·00	42·51	40·60
Alumina	22·00	19 15	19·95
Protoxide of iron	36·00	33·57	33·93
Protoxide of manganese	00 00	5·49	6·69
Lime	3·00	0·00	00·00
	97·80 Vauquelin.	101·82 Wacht'r.	101·17 Wacht'r.

Sp. Gr. 4·2. H. between 6·5 and 7 5.

The principal color of this beautiful mineral is red of various shades, having sometimes a tinge of yellow or blue, or a smoky aspect: it is commonly translucent, often transparent. It occurs crystallized in the rhombic dodecahedron, and may sometimes be cleaved, though not without difficulty, parallel to the planes of that solid,—this is therefore considered its primary form. Fracture conchoidal, with a shining, vitreous lustre. B B, *per se*, it fuses into a black globule, which acts upon the magnet, and with borax melts slowly into a dark glass tinged by iron. Insoluble in acid.

The almandine is much esteemed as a precious stone. Its principal localities are Ceylon and Pegu, where it occurs in alluvial deposits, and Greenland, whence many fine stones have been obtained for the purposes of the lapidary. In smaller but most beautiful crystals, it is found accompanying diopside and talc, at Ala in Piedmont; sometimes near Ely in Fifeshire; and in several parts of Bohemia. It is believed to be the common *carbuncle* of the ancients, though they also applied this term to the ruby, as well as to other gems.*

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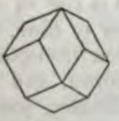
* Grenat, Fr; of the color of pomegranate seeds.

In the United States highly perfect and polished dodecahedrons of precious garnet are abundant in a compact hornblendish rock at Hanover, N. H. These rarely present any other modifications than the simple replacement of the edges by one plane (*émarginé* of Haüy), fig. 2 of the next variety; but at Franconia and Lisbon, in the same state, very brilliant crystals, with their edges replaced by three planes (*tri émarginé* of Haüy), as represented by the large figure under the same variety, accompany the beds of iron ore in the form of geodes, associated with calcareous spar, and sometimes with byssolite. In New York, on the Croton Aqueduct, near the village of Yonkers, according to Prof. Beck, it occurs abundantly in black mica and gneiss of a rose-red and dark red color, in crystals from a quarter to half an inch in diameter; and, when cut and polished, it forms a beautiful gem. A large irregular crystalline mass of this mineral, found in the same neighborhood, weighed about 60 pounds.

2. Common Garnet. Gemeiner granat, W. Grenat brun, &c. H. Color reddish-, yellowish-, greenish-, or blackish-brown, and it differs from precious garnet in being commonly opake, or only translucent. It is found in granular masses, and crystallized in dodecahedrons, which are often considerably modified. Not quite so hard as almandine; fracture sometimes uneven, sometimes lamellar.

1.



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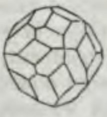

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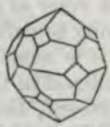

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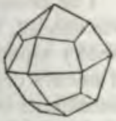

Fig. 1, primary rhombic dodecahedron. Fig. 2, the same, all the edges being replaced by six-sided planes, which, being further advanced in fig. 3, reduce those of the primary crystal to small rhombs; and being complete in fig. 4, assume the form of trapeziums, forming the trapezoidal garnet, consisting of 24 similar and equal trapezoidal faces, in which no portion of the primitive planes is visible. Figs 2 and 3 have each 36 faces, of which 12 are rhombs and 24 are hexaedrons.

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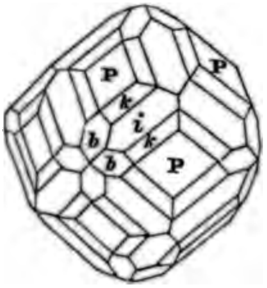
* Moore's Ancient Mineralogy, p. 155.

Fig. 5.



	Haüy.
P or P on P	120°
P on *i*.	150°
P on *k*	160° 53′ 36″
k or *k* on *i*	169° 6′ 24″
b or *b* on *i*	155° 54′ 48″

Common garnet is abundantly disseminated in some of the older rocks, as mica slate, serpentine, and gneiss; and sometimes in granite. It is met with in most countries in which those rocks occur, and is often so abundant as to form an important ore to the iron smelter. Regular dodecahedrons of several pounds weight have been found at Fahlun in Sweden; also at Arendal and Kongsberg in Norway; and in the Zillerthal, Tyrol. In the mica slates of Perthshire, Inverness-shire, Shetland, and the Isle of Mull, it is of frequent occurrence. At Schwartzenberg in Saxony, and in the Bannat, it presents peculiarly green-colored crystals; and at Vesuvius occupies the cavities of ejected debris.

In the United States common garnet is very generally diffused throughout the primitive rocks, and mineralogists are too familiar with its localities to require an enumeration of them. At some localities it enters into the composition of the rock to an extent almost equal to that of either of the regular ingredients. For the numerous localities the student may consult *Robinson's Catalogue of American Minerals.*

3. PYRENEITE. Pyrenit, W. Pyreneite, J. This variety of garnet is black, and occurs in minute but very symmetrical rhombic dodecahedrons, which glisten externally. The fracture is uneven. It is opake, hard, and B B loses its color, melting easily into a porous black slag. It occurs imbedded in primitive limestone, in the Pic Eres-Lids near Barèges in France, and in mica schiste in the Pyrenees.

4. GROSSULARITE, or GREEN GARNET. The following analyses will show it to be composed of simple silicates, the atoms of bases agreeing with those of silica. The iron being united to the alumina, and the manganese to the lime, their atoms become almost equal, as shown by calculation from the last analysis. The mineral is therefore a silicate of alumina and lime. Formula $AlS+CalS$.

	Norway.	Wiloui.
Silica	38 80	40·55
Alumina	20·40	20·10
Lime	32 00	34·86
Protoxide of iron	8·35	5·00
Protoxide of manganese	00·00	0·48
	99·55 Richardson.	100·99 Wächtmeister.

Sp. Gr. 3·372. H.=6·75.

This rare mineral generally assumes the trapezoidal form of crystallization. It is light olive-green;* translucent or semi-transparent; hard, and brilliant externally. Its fracture is conchoidal, and its fragments possess a vitreous lustre. Its comportment B B is similar to that of almandine, only that the glass produced is of a brownish color. It occurs, with idocrase, in a greenish grey argillaceous rock, near the river Wiloui in Siberia, and at Telmarken in Norway.

5. Cyprine. The mineral from the last-named locality has been usually regarded as a variety of idocrase, and described under the name of cupreous idocrase, or cyprine; but from the analysis by Mr. Richardson in Dr. Thomson's laboratory, it appears that it contains no copper, but gives the same results as were obtained by Wächtmeister, in his analysis of grossularite. There can be no doubt of the identity of the two minerals.† It exhibits occasionally crystalline faces, and has a beautiful smalt-blue tinge. Its specific gravity is 3·2278. It fuses readily with effervescence into a globule which becomes black in the oxidating flame, and red in the reducing one. The analysis is above stated.

6. Uwarowite.‡ Chrome Garnet. This is a rare variety of garnet, made known by one of the industrious mineralogists of Russia, and which probably should be classed here with green garnet, to which it bears a very close resemblance. In its lively green color it also resembles acherite, a variety of dioptase, but it contains no copper, and crystallizes in perfect rhombic dodecahedrons, which are disposed on grounds of chromate of iron; and from oxide of chrome its beautful emerald-green color is supposed to be derived. The crystals are nearly transparent. Hardness 7·5. It is rather more difficult of fusion than garnet, but it is proved to belong chemically to this class of minerals. When heated it does not give out water, nor decrepitate, nor change its color. With borax it fuses with difficulty into a

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* Grossulaire, Fr. gooseberry, from its green color.

† It has therefore been separated from idocrase, under which it had been classed in the previous edition of this work. No other analysis of the mineral has been published. See Outlines of Mineralogy, &c., vol. i., p. 262. [Am. Ed.]

‡ In honor of M. Uwarow, President of the Imperial Academy of Sciences, St. Petersburg, and described by Von Hess, in vol. i. of the Trans. of the Imp. Min. Soc. of St. Petersburg, p. 131: or Poggendorf's Annalen, xxiv. 388.

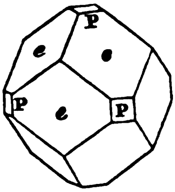
clear chrome-green glass. It was found at Bissersk, in the Ural Mountains: also recently in one of the Russian mining districts, attached to masses of platinum. It has not been analysed.

7. **Aplome.** Aplome, H. Combination of 1 atom silicate of lime and 1 atom silicate of peroxide of iron. It should be observed, also, that it has the same constitution as idocrase, though in hardness and crystalline form the two minerals differ essentially from each other, a fact which we well know has other analogies in mineralogy. Formula $CalS+\underset{\cdot}{F}S$.

	Altenau.
Silica	35 64
Lime	29 22
Peroxide of iron	30·00
Protoxide of manganese	3·01
Potash	2·35
	100·22 Wächtmeister.

Sp. Gr. 3·44. Harder than quartz.

It is usually considered a variety of garnet, with which it agrees in external form as well as in general aspect; but differs in this respect, that although it commonly occurs in rhombic dodecahedrons, its planes are striated parallel with their lesser diagonal, which, in Haüy's opinion, indicates its primary not to be a rhombic dodecahedron, but a cube.* It is usually of a deep brown or orange-brown color; is opake, and somewhat harder than quartz. It is fusible into a black glass.



P on P . . . . . 90°

e on *e* . . . . 120°

P on *e* . . . . 135°

Aplome is found on the banks of the river Lena in Siberia, in the Bannat, and at Schwartzenberg in Saxony.

8. **Manganesian Garnet.** Grenat manganésie, Bt. Spessartine, *Beudant:* of which the protoxide of manganese forms from 20 to 35 per cent.

	Spessart.	Brodbo.	Haddam.
Silica	35·00	39·00	35·83
Alumina	14·25	14 30	18·05
Peroxide of iron	14 00	00·00	00·00
Protoxide of iron	00·00	15·44	14·93
Protoxide of manganese	35·00	27·90	30·96
	98·25 Klaproth.	97·64 D'Ohsson.	99·78 Seybert.

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* Whence Aplome, in allusion to the ready transition of the cube into the rhombic dodecahedron.

Beudant (*Traité*, tome ii., p. 52) records five analyses of this variety including the three here given, and adds this formula: $AlS+\underline{M}nS$. In the second and third, the protoxide of iron is included with the manganese, and the peroxide with alumina, in the first analysis.

This mineral occurs massive, and in dodecahedral crystals variously modified; it is slightly translucent on the edges. It does not appear to possess any regular structure; fracture commonly vitreous and imperfectly conchoidal; color deep hyacinth or brownish red. It is fusible B B, and, by the decided green color it exhibits with soda on platina foil, marks distinctly the presence of manganese.

It occurs in granite near Aschaffenberg, in Franconia; at Finbo and Brodbo near Fahlun in Sweden; and elsewhere. In the United States, at Haddam, Ct., it occurs in crystals which are sometimes four inches in diameter, of a laminated structure, presenting broad faces of cleavage, and are extremely brittle. It there accompanies crysoberyl and smoky quartz. At Jones Eddy, near Bath, Me., it is in a massive form, and abundant.

9. Brown Manganese Garnet. This is the name Dr. Thomson has given to the well-known mineral accompanying the franklinite, at Franklin, N. J., a specimen of which had been sent to him for analysis by Dr. Torrey. The results of his analysis and of one by Seybert,* which differ considerably from that of the last variety described, are here given:

Silica	33·716	32·80
Lime	25·884	27·80
Alumina	7·972	3·06
Protoxide of iron	15·840	27·56
Protoxide of manganese	16·704	6·32
Water	0·080	1·24
Magnesia	0·000	1·01
	100·196 Thomson.	99·79 Seybert.

Divided by the atomic weights, the first analysis gives an excess of atoms of bases over those of silica; while, by the second, throwing out the water and magnesia, the atoms of bases and of silica almost precisely agree; but nearly two thirds of the protoxide of manganese are replaced by protoxide of iron. This mineral differs from the common manganesian garnet by containing a large portion of lime, which does not exist at all in that variety; and also in its physical characters, and crystalline form; by which, when further examined, it will probably prove to be a distinct species. It is usually massive, titanium, and 1·0 water. Trollé Wächtmeister has published ten analyses of this mineral, the mean of which gives an equal number of atoms of bases and of silica, or shows the mineral to consist of simple silicates of lime and iron, or 1 atom of each. Formula: $\mathrm{Cal\,S}+\mathrm{F\,S}$. His last analysis differs not materially from the following, by Seybert. It is thus stated:

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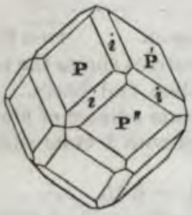
* Cleaveland's Mineralogy, Second Edition, p. 797.

	Altenau.
Silica	35·64
Protoxide of iron	30·00
Protoxide of manganese	3·02
Magnesia	2·35
Lime	29·21
Water	00·00
	100·22 Wächtmeister.

Silex	32·80
Lime	27·80
Alumina	3·06
Magnesia	1·24
Protoxide of iron	27·56
Protoxide of manganese	6·32
Water	1·10
	100·43 Seybert.



P on P or P″ . . . 120°.

P, P′ or P″ on i . . 150°.

It is found with magnetic iron ore at Arendal in Norway, in talc slate in Piedmont, also in Ceylon. In the United States it is found most abundantly at Willborough, N. Y., where it forms a vein consisting of coarse granular and lamellar concretions in gneiss, and possesses beautiful colors. Also at Rogers Rock, in a finer grained variety, of a yellow and red color. A rose-red, fine, granular variety, has been found by Shepard at North Madison, Ct.

12. **Allochroite** is of a greyish, dingy yellow, or reddish color,[*] and opake; its composition is impalpable, or the particles so intimately connected that they cannot be distinguished; not so hard as quartz, but gives fire with steel; fracture uneven. B B comports itself like melanite. Contains silica 35·0, alumina 8·0, lime 30·0, oxide of iron 17·0, oxide of manganese 3·5. —*Vauquelin.* The allochroite is principally found in an iron mine near Drammen in Norway.

13. **Pyrope.**[†] Pyrop, W. Grenat, rouge de feu, granuliforme, H. It differs from the other varieties in containing 7·68 per cent. of chromic acid, and by having a part of its iron re-

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[*] Whence probably its name, from two Greek words signifying of various colors.

[†] From the Greek, signifying a fire-red color.

placed by magnesia. The early analysis by Klaproth discovers no chromic acid, and the two last analyses give atomic proportions that cannot be stated by the same formula.

	Bohemia.	Trziblitz.	Meronitz.
Silica	40·00	42·08	43·70
Alumina	28·50	20·00	22·40
Lime	3·50	1·99	6·72
Magnesia	10·00	20·19	5·60
Protoxide of iron	16·50	10.60	11.48
Protoxide of manganese	0·25	0·32	3·68
Chromic acid	0·00	3·01	7·68
	98·75 Klaproth.	98·19 Kobell.	100·26 Wächt.

Sp. Gr. 3·8 H. = 7·5.

It is found only in rounded or angular grains, of a red color, which is sometimes clouded with yellow: rarely crystallized. It is transparent, has a conchoidal fracture and vitreous lustre, and scratches glass; that of Ceylon, B B, fuses into a brilliant black globule, with borax into a chrome-green glass.

Pyrope is found imbedded in serpentine at Zoeblitz in Saxony, and in traptuff wacke at Meronitz and Trziblitz in Bohemia, but is more common in the latter country; and in Ceylon, in alluvial deposits, accompanied by hyacinths and sapphires.

This rich variety is rarely found in the United States. The most important locality is Green Creek, Delaware County, Pa., where rolled masses of more than an inch in diameter have been obtained, the finest of which are in the cabinet of J. A. Clay, Esq. of Philadelphia. According to Prof. Beck, it is found in Westchester County, N. Y., in gneiss, and is often transparent, varying in color from rose to blood-red, with a tint of blue. At Sturbridge, Mass., it has been found by Professor Hitchcock in gneiss, accompanying graphite. Specimens of this pyrope which have been cut and polished are equal in appearance to any from abroad which have undergone similar treatment. Several of those obtained by Prof. Hitchcock may be seen in the Massachusetts State Collection. Pyrope, according to Dr. Jackson, also accompanies the plumbago at Jeffrey, N. H., where it is included in granite veins on Monadnock Mount.

14. TOPAZOLITE.* Topazolite. — *Bonvoisin*. This variety of garnet occurs in remarkably well-defined dodecahedrons, of a topaz-yellow color, either perfect, or more commonly exhibiting a very low four-sided pyramid on each plane; occasionally also of an olive-green; translucent. It consists of silica

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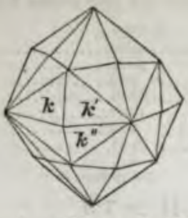
* So named from its color being of a nearly topaz-yellow.

35·10, magnesia 2, lime 29, *glucina* 4, iron 25, manganese 2. —*Bonvoisin.*



k on k′ . . . . . 179° 10′.
k on k″ . . . . . 178° 40′.

It is found at Mussa in Piedmont, sometimes upon mussite.

The *Succinite* of Bonvoisin is considered to be an amorphous variety of topazolite. It is amber-yellow* and translucent, and occurs in small rounded masses: it is not hard enough to scratch glass, but easily pulverizes, and melts into a blackish globule B B.

Its locality is a serpentine rock in the Vin valley, forming part of the great valley of Lans in Piedmont.

15. CINNAMON-STONE.† Kaneelstein, W. Essonite, H. The following analyses show the per centage composition of this interesting variety:

	Ceylon.	Ceylon.	Malsjo.	Ceylon.
Silica	38·80	40·0	41·87	39·82
Alumina	21·20	22·99	20·57	20·14
Lime	31·25	30·57	33·94	30·57
Protoxide of iron	6·50	3·66	3·93	9·46
	97·75 Klaproth.	97·12 Gmelin.	100·31 Arfwedson.	99·49 Lehunt.

The protoxide of iron, which is in variable proportions, Beudant unites with the lime in the formula, which is thus stated by him: AlS+CalS. Dividing by the atomic weights, we find the atoms of bases to agree with those of silica, and obtain the above atomic constitution of this mineral from either of the analyses. It thus has precisely the same formula with grossularite and idocrase, from the last of which it differs entirely in crystalline form.

Sp. Gr. 3·5 — 3·6. H. = 6·5.

This mineral commonly occurs in masses which are full of fissures. Its general color is red, with occasionally a brown or orange-yellow tinge; translucent, rarely transparent; fracture flat conchoidal; lustre vitreo-resinous; scratches quartz with difficulty. B B, it is fusible with ebullition into a darkish green glass, and with borax melts very readily into a transparent glass, more or less feebly tinged by iron.

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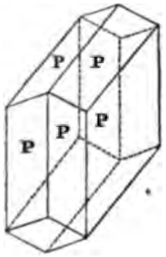
* Succin, Fr., Amber; whence Succinite.

† Its name is probably derived from the resemblance of its color to that of cinnamon.

It has been found in considerable masses in some of the primitive rocks of Ceylon, and imbedded in limestone at Malsjo in Sweden; but is most commonly met with in grains among the sand of certain rivers, both in Ceylon and in Brazil.

The *Romanzovite* of Nordenskiold is considered a variety of cinnamon-stone. Its color is brown or brownish black, and it is described as occurring either compact or in crystalline plates which indicate the rhombic dodecahedron; fracture resinous, with a greasy lustre; brittle, but hard enough to scratch felspar; streak light yellow. B B, it melts without ebullition. Contains silica 41·24, alumina 24·08, lime 24·76, oxide of iron 7·02, magnesia and oxide of manganese 0·92, volatile parts and loss 1·98. — *Nordenskiold.* It occurs at Kimito in Finland.

There are three remarkable localities of the cinnamon-stone variety of garnet in the United States, viz: Carlisle and Boxborough, Mass., and Phippsburg, Me. The crystals from the first-named locality (discovered by Professor Webster) are imbedded in limestone, and accompanied by idocrase, sahlite, pargasite, and scapolite. The small ones of a perfect dodecahedral form are nearly transparent, and present highly polished surfaces; some were found quite clear on their surfaces, and more than an inch in diameter, with their angles and edges replaced. The specimens from Boxborough and Phippsburg present nothing worthy of distinct description, as they resemble in every respect those already mentioned; but the latter locality at the present day will probably furnish the mineralogist with the best specimens of these most beautiful gems. Crystals, sometimes four inches in diameter, have also recently been discovered in the limestone of Amherst, N. H. They are of a pale brown color, and but rarely possess highly polished surfaces. They are accompanied by sahlite and pargasite, and are said to be very abundant. The crystals from Phippsburg in some cases present the primary dodecahedron in which two of the opposite faces are so much enlarged or compressed as to give to it the appearance of a flattened table, as shown in the annexed figure. Rarely, also, by the extension of six faces of the primary, they have assumed the appearance of six-sided prisms, terminated by trihedral pyramids, all the edges being replaced by tangent planes, as in the common emarginated crystals.



IDOCRASE.*

Vesuvian, W. **Idocrase**, H. **Pyramidal Garnet**, M. **Carbunculus Dimetricus**, D.

Composed, according to the careful analysis of Magnus, (*Poggendorf's Annalen*, xxi., 50), as follows:

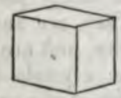
	Vesuvius.	Uralian Mountains.	The Bannat.	Egge.
Silica	37·359	37·178	38·519	37·658
Alumina	23·530	18·107	20·063	17·695
Lime	29·681	35·791	32·411	31·896
Protoxide of iron	3·992	4·671	3·420	4·537
Magnesia	5·208	0·773	2·987	6·489
Protoxide of manganese		1·495	0·018	0·499
	99·770	98·015	97·418	98·774

Calculating the atomic constitution of this mineral from the mean of these four analyses, and rejecting the variable portions of magnesia and protoxide of manganese as accidental, the atoms of bases (including the iron with the alumina) agree with the atoms of silica. It is therefore composed of simple silicates, expressed by the formula, $AlS+CalS$.†

Sp. Gr. 3·8 to 3·4. H. = 6·5.

Idocrase occurs crystallized, either solitary or in groups; and massive. The general form of the crystals is a quadrangular prism, which sometimes is terminated by planes, and the edges of the prism are often replaced; primary form a right prism with square bases; yielding readily to cleavage parallel to all its planes, with sufficient brilliancy to obtain incidences of 90° by the reflecting goniometer in every direction; the prism is also divisible parallel to both its diagonals, though not easily: fracture small conchoidal, and shining. Idocrase is mostly brownish- or yellowish-green, sometimes orange, rarely black; generally translucent, sometimes nearly transparent; possesses double refraction; is fusible with ebullition into a yellowish translucent globule, and forms with borax a diaphanous glass tinged green by iron.

1.



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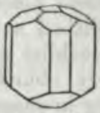

3.

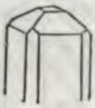

Fig. 1, the primary; a right prism with square bases. In fig. 2 the lateral edges of the prism are replaced by quadrangular planes, and a portion of the summit is replaced by four six-sided planes. In fig. 3 the quadrangular planes replacing the edges of the prism are very much increased, so as greatly to reduce the lateral primary planes.

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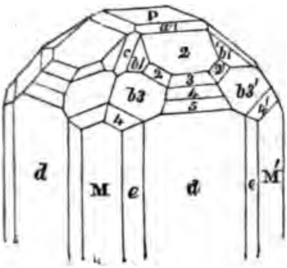
* Idocrase, in allusion to its form; a mixed figure, assuming that of other species. Vesuvian, from its having been first discovered on Vesuvius.

† The analysis of egeran by Borkowsky, gives the same formula. (See Beudant, Traité, t. ii., p. 67.) They thus agree with the formula for essonite and grossularite.



M on M′ or *d* on *d* . . .	90°	0′
P on M M′ or *d*	90	0
M or M′ on *d*	135	0
— — — — *e*	153	27 H.
d on *e*	161	33 H.
P on *a* 1	166	6
—--*a* 2	142	48
— — *a* 3.	124	30
— —*a* 4.	113	30
— — *b* 1	140	12
M on *b* 1.	128	5
— —*b* 2.	138	30
— —*b* 3.	145	5
— — *b* 4.	152	3 H.
M on *c*.	118	8 H.

Idocrase is met with both in volcanic and primitive countries. It occurs at Monte Somma, or in the ejected masses of Vesuvius, where its crystals line the cavities of volcanic rocks, accompanied by garnet, hornblende, melanite, mica, and icespar. Crystals, occasionally of large dimensions, are found at this locality; but their forms are complicated. The previous fig. 3 is the usual crystallization of the Siberian idocrase, which is met with in a greenish white serpentine, near the Lake Baikal, and on the banks of the Wiloui; but by far the finest specimens come from Ala in the Val di Brozzo, in Piedmont: these are in general semi-transparent, present fine olive-green, hair-brown, and, though rarely, perfect black colors: are deeply streaked longitudinally, and are as remarkable for lustre and brilliancy as for the symmetry and perfection of their crystalline forms. Large, well-defined, opake crystals, often exceeding four or five inches in diameter, occur at Egge near Christiansand in Norway. At Monzonia, in the Fassa valley, crystals of a sulphur-yellow color have been found.

EGERAN. It occurs in diverging groups of deeply streaked translucent crystals, of a liver-brown color, whose form is that of a right rectangular prism, having its lateral edges replaced. B B, it melts with intumescence into a greenish blebby glass. It occurs at Haslau, near Eger,* in Bohemia, and is sometimes accompanied by quartz and tremolite. It here occurs in long, reddish brown, deeply striated forms, and in columnar masses: also, under similar circumstances, in Finland.

Idocrase is very rare in the United States, and, at the time of the publication of the second edition of Cleaveland's Mineralogy, it would seem that not a single locality was publicly known. The locality which has since supplied the best specimens of the variety egeran is at Worcester, Mass., where it was found in a quartzose rock, in veins, accompanied by pyroxene and garnet. The same variety has been found at Phippsburg, Me., with cinnamon-stone and axinite: also in limestone at Washington, Ct.; and in the same rock, in crystals sometimes an inch in diameter, at Amity, Orange County, N. Y.

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* Whence Egeran.

XANTHITE.[*]

This mineral is composed, according to the analysis of Dr. Thomson, of

Silica	35·092
Lime	33·080
Alumina	17·428
Peroxide of iron	6·368
Protoxide of manganese	2·801
Water	1·680
	98·430

Dr. Thomson made two analyses of this mineral; but the one here given was instituted on the purest specimen. The iron and manganese he regards as accidental, and he records the following formula: $6CalS+5AlS$.

The claims of this mineral to the character of a distinct species are founded on the examinations of Dr. Thomson and Prof. Mather,[†] by which it is shown to differ in chemical, physical, and crystallographical characters from the preceding species, of which it has been supposed to be a variety. Its hardness does not exceed 2; specific gravity 3·221; translucent and even transparent, possessing double refraction. B B, *per se*, it does not fuse; with borax melts into a glass which is yellow while hot, and becomes colorless in cooling. It readily yields to cleavage, giving a doubly oblique prism, measuring, according to Prof. Mather, P on M 97° 30′, P on T 94°, M on T 107° 30′, as determined by the reflecting goniometer. The cleavage planes may be exhibited very plainly by holding the laminated masses to the light. The color is light greyish or yellow.

It occurs at Amity, N. Y., under similar circumstances with the species last described, in granular and foliated masses, which are very friable, and separate into grains and prisms about $\frac{1}{20}$ of an inch in length.

GEHLENITE.[‡]

Stylobite, *Beudant*. Spatum Gehlenianum, D.

Combination of silica, alumina, lime, and oxide of iron.

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[*] From its yellow color, named by Dr. Thomson. See Annals of the Lyceum of Natural History of New York, for April 18, 1828.

[†] American Journal of Science, vol. xviii., p. 359.

[‡] Gehlenite, in honor of the German chemist, M. Gehlen.

	Tyrol.	Tyrol.	Tyrol.
Silica	29·64	29·132	39·80
Alumina	24·80	25·048	12·00
Lime	35·30	37·380	37·64
Oxide of iron	6·56	4·350	2·31
Water	3·30	4·540	2·43
Magnesia	00·00	00·000	4·64
	99·60 Fuchs.	100·450 Thomson.	99·22 Kobell.

The two first are the analyses of crystallized specimens; the latter of the compact variety. Dr. Clarke has published another analysis, so different in its results from either of these, that Beudant questions whether the mineral really was gehlenite. The two first conduct to the formula, $Al^2S+2CalS+Aq$. — as stated by Beudant, the iron being united with the lime.

Sp. Gr. 2·98 to 3·02. H. = 5·5 to 6.

According to Brooke, the primary form of this mineral is uncertain;* but it occurs in right square prisms, nearly approaching, in their dimensions, the form of the cube; sometimes isolated; generally invested by calcareous spar; aggregated irregularly in groups: or massive, including pleonaste. Its usual color is grey, but frequently having a greenish or yellowish tinge; surface commonly rough and dull; when sufficiently brilliant for the use of the reflecting goniometer, the crystals afford angles of 90° in every direction. Fracture uneven, passing into splintery: opake, the fragments feebly translucent on the edges. B B, gehlenite suffers little change when alone; with borax it melts with difficulty into a glass colored by iron. It gelatinizes in heated muriatic acid.

Mount Monzoni, in the Valley of Fassa, Tyrol, is its only well authenticated locality, although Monticelli mentions it as occurring, indistinctly crystallized, among the productions of Vesuvius. At the former place it is encompassed by calcareous spar, and the greenish and greyish substance which accompanies the spinels and idocrase of the same region, has been regarded as compact gehlenite.†

PREHNITE.‡

Prehnite, W. H. Axotomous Triphane Spar, M. Clasistylus Acrotomus, D.

Combination of silica, alumina, lime, and water.

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* Encyclopedia Metropolitana, Article Mineralogy, p. 491.

† Fuchs, in speaking of this mineral in 1815, says he considers the oxide of iron not as an essential part of it, but only as a *vicarious* constituent replacing so much lime. This was probably the first ushering in of the doctrine of isomorphism, since established by Mitscherlich, and now so important in enabling us to arrive at the true constitution of minerals. [Am. Ed.]

‡ In honor of Colonel Prehn, its discoverer, who first brought it from the Cape of Good Hope.

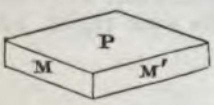
	Cape of Good Hope.	Dumbarton.	Reicherbach.
Silica	43·80	43·00	42·50
Alumina	30·33	23·00	28·50
Lime	18·33	22·33	20·40
Oxide of iron	5·66	2·00	3·00
Water	1·16	6·40	2·00
	99·28 Klaproth.	97·33 Thomson.	96·40 Laugier.

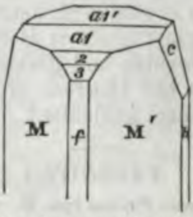
The first analysis was of a foliated specimen; the other two were of fibrous varieties. From the mean of seven analyses, including these three, Dr. Thomson obtains the formula, $2AlS+CalS^{1\frac{1}{2}}+\frac{1}{2}Aq$. He unites the protoxide of iron with the alumina.

Sp. Gr. 2·926. H. = 6·0 to 7·0.

Generally of a pale greenish or yellowish color, with a vitreous or pearly lustre, and somewhat translucent; becomes electric by heat, and is slowly soluble in dilute muriatic acid. It occurs fibrous, massive, and in crystals, which are, for the most part, closely aggregated: their primary form is a right rhombic prism, M on M′ 99° 50′; but the crystals are subject to modification by two planes on the summit, $a1$ $a1'$, of the following figure. It presents several varieties of form. Cleavage distinct parallel to P, less so parallel to M. *Per se*, it fuses with intumescence into a white or pale-yellowish frothy glass; and with borax forms a transparent bead.

17. **Koupholite**,* a variety in small transparent rhombic tables (fig. 1) from Baréges in the Pyrenees; has a white or yellowish-white color, and a glistening pearly lustre. It consists, according to Vauquelin, of 48 silica, 24 alumina, 23 lime, and 4 oxide of iron; and it is fusible into a white frothy glass.


Primary form.



M on M′ . . . . 99° 50′
P or M on M′ . 90 00
M or M′ on *f* . 139 45
$a1$ on $a1'$. . . . 177 20
— — *f* 92 00
— — M or M′. 91 30
M on *c*. 128 30

Crystallized prehnite in considerable quantity, and of a purer green than that of Europe, is found at the Cape of Good Hope; it occurs in the Fassa valley, Tyrol, of a peculiar bluish green hue; with axinite and epidote, at St. Christophe in Dauphiné; in Carinthia, Sweden, and elsewhere. In England it has been noticed in Staffordshire, at Woodford in Gloucestershire, and at Botallack, near the Land's End, Cornwall. In

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* From two Greek words signifying a light stone.

Scotland it is abundant in veins traversing trap near Dumbarton; at Hartfield Moss, near Paisley; at Frisky Hall, near Glasgow; at the Castle Rock and Salisbury Crag, near Edinburgh; in the Isles of Mull and Skye, &c. The Scotch varieties in general exhibit radiated, botryoidal, orbicular, or mammillated masses of various colors, from apple-green to straw-yellow; the latter particularly at Salisbury Crag: sometimes translucent and colorless, as at the Castle Rock; and very often white and opake, as in Dumbartonshire.

In the United States large, well-formed, pale green colored crystals have been found in trap rock at Scotch Plains and Patterson, N. J., and at Farmington and Middleton, Ct.; also in very rich deep green crystals, associated with laumonite and chabasie in sienite, at Charlestown, and recently in the granite quarries at Medford, Mass. It is a singular fact that not a crystal of this species has ever been met with in the trap rocks of Nova Scotia.

STILBITE.[*]

Strahl Zeoilth, W. Stilbite, H. Bt. Radiated Zeolite, J. Prismatoidal Kouphone Spar, M. Vulcanus Fascicularis, D.

	Iceland.	Faroe.	Nalsöe.	Dumbarton.
Silica	58·00	59·25	56·08	52·50
Alumina	16·10	15·00	17·22	17·31
Lime	9·20	5·35	6·95	11·52
Water	16·40	6·00	18·35	18·45
Potash	00·00	4·75	2·17	00·00
	99·07 Hisinger.	99·50 Duménil.	100·77 Retzius.	99·78 Thomson

Formula, as given by Beudant from the three first analyses, and as also stated by Dr. Thomson from the mean of five analyses, including his own: $3AlS^3+CalS^3+6Aq$. The potash is to be regarded as an accidental and variable constituent, as in three out of five analyses which have been published, none was found.

Sp. Gr. 2·0 — 2·2. H. = 3·5 to 4·0.

Its colors are white, grey, red, and brown; translucent; lustre vitreous, except on the faces T, which exhibit a peculiar glistening or shining pearly appearance; primary form a right rectangular prism, in which it sometimes occurs; but it is more frequently found in prisms of which the edges are replaced, and which are terminated by tetrahedral summits; the planes forming the pyramids being placed on the angles of the prism.* The crystals are usually aggregated or compressed into scopiform or fasciculated masses, which, when broken, present radiations from the centre. Cleavage parallel to the planes T and M, the latter only being perfect; fracture uneven; surface P frequently curved, M and T vertically streaked. It intumesces B B, and runs into a blebby colorless glass. It does not gelatinize with acids.

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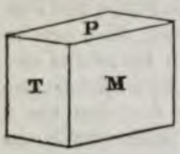
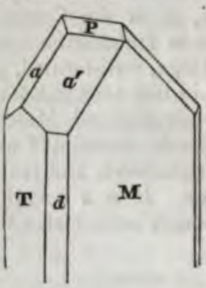
[*] From στιλβω, to shine, on account of its great lustre. It has been very properly suggested by Dr. Thomson that this term should rather apply to heulandite, the mineral in which the lustre is most remarkable, and to which it was probably first applied when it was separated from zeolite. Perhaps it would be well to call it simply zeolite, it being the most common of this class of minerals. [Am. Ed.]

Primary Form.





M on T	90°	0′	
P on M or T .	90	0	
M on *a*′	120	30	
a on *a*′	119	15	[†]
M on *d*	136	30	

Stilbite is met with occasionally in the fissures of primitive rocks, and in mineral veins; but its principal repositories are the cavities of trap. The Faroe Islands and Iceland are the great localities of this beautiful mineral. Splendid specimens have also been brought from Indore in the Vendayah Mountains of Hindustan, and from Poonha, where it is accompanied by poonhalite and a beautiful gem-like green apophyllite. And very beautiful crystals, of a brick-red color, occur in porphyritic amygdaloid, near Kilpatrick in Dumbartonshire; and in the Fassa Valley, Tyrol. Dauphiné, Andreasberg in the Hartz, Arendal in Norway, Gustafsberg near Fahlun in Sweden, and the island of Arran, are also well-known localities of stilbite; at most of the latter it being found in granite and other primitive rocks. It has also been brought from New Holland.

It occurs abundantly in the Kilpatrick Hills and other trap rocks in the neighborhood of Glasgow. It is the most common mineral in the amygdaloid of Nova Scotia, often forming continuous veins of considerable thickness and various shades of color, associated with, and containing in its cavities, the various other interesting minerals of that region, for the particular localities of which the student may consult a Memoir on the Mineralogy and Geology of Nova Scotia, published in the

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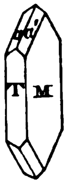
[*] According to Levy, the primary form of stilbite is a right rhombic prism, M on M′ 94° 11′.

[†] As correctly stated by Dana, there being a difference of three degrees in the last measurement, as now given, compared with that approximated by Phillips, and recorded in the last edition of this work. [Am. Ed.]

American Journal of Science, vols. xiv. and xv., and, as enlarged, in the *Transactions of the American Academy of Science* (*New Series*,) vol. i., 1833.

The stilbite from Nova Scotia rarely separates itself from the fasciculated forms in which it usually occurs, and in which sufficient freedom is not given for the production of perfect crystals; but perfect individuals are sometimes implanted on quartz, presenting the primary prism compressed into low four-sided tables, with the replacements of the solid angles *a a'*, elongated, forming regular beveled edges to the tables, as represented in the annexed figure. This is the common form in which the crystals of this mineral come to us from the Faroe Islands.



In the United States, owing to the infrequent occurrence of extensive masses of the newest trap rocks, it rarely occurs under the striking forms in which it is presented to us from abroad. It is found sparingly in the trap range of Connecticut and Massachusetts; but the coarse greenstone of Piermont, N. Y., and Bergen Hill, N. J., has as yet supplied much the finest specimens. The crystals are yellowish, but sometimes of a pure white color, nearly transparent, and with very brilliant faces; they are implanted on carbonate of lime, or interspersed with analcime and apophyllite; rarely in fasciculated masses. It also forms narrow seams in some of the primitive rocks, as at Hadlyme, in Connecticut; opposite West Point; at the Harlem Tunnel, and near West Farms, New York; at Bellows Falls, Vermont.

HEULANDITE.

Blätter Zeolith, W. Var de Stilbite, H. Foliated Zeolite, J. Heulandite, *Brooke.**
Hemi-prismatic Kouphone Spar, M. Vulcanus Rhomboideus, D.

Combination of silica, alumina, lime, and water.

	Red, Campsie.	*Red*, Edelfors.	*White*, Faroe.
Silica	59·95	60·28	59·14
Alumina	16·87	15·41	17·92
Lime	7·19	8·18	7·65
Water	15·10	11·07	15·40
Oxide of iron	0·00	4·16	00·00
	99·11 Walmstedt	99·10 Retzius.	100·11 Thomson.

It consists, according to the mean of the first and last analysis, of 4 atoms tersilicate of alumina, 1 atom tersilicate of lime, and 6 atoms water. Formula: $4AlS^3+CalS^3+6Aq$. It thus differs in composition from stilbite, in containing an additional

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* Edin. Phil. Jour., vol. vi., p. 112.

IDOCRASE.*

Vesuvian, W. Idocrase, H. Pyramidal Garnet, M. Carbunculus Dimetricus, D.

Composed, according to the careful analysis of Magnus, (*Poggendorf's Annalen*, xxi., 50), as follows:

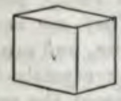
	Vesuvius.	Uralian Mountains.	The Bannat.	Egge.
Silica	37·359	37·178	38·519	37·658
Alumina	23·530	18·107	20·063	17·695
Lime	29·681	35·791	32·411	31·896
Protoxide of iron	3·992	4·671	3·420	4·537
Magnesia	5·208	0·773	2·987	6·489
Protoxide of manganese		1·495	0·018	0·499
	99·770	98·015	97·418	98·774

Calculating the atomic constitution of this mineral from the mean of these four analyses, and rejecting the variable portions of magnesia and protoxide of manganese as accidental, the atoms of bases (including the iron with the alumina) agree with the atoms of silica. It is therefore composed of simple silicates, expressed by the formula, $AlS + CalS$.†

Sp. Gr. 3·8 to 3·4. H. = 6·5.

Idocrase occurs crystallized, either solitary or in groups; and massive. The general form of the crystals is a quadrangular prism, which sometimes is terminated by planes, and the edges of the prism are often replaced; primary form a right prism with square bases; yielding readily to cleavage parallel to all its planes, with sufficient brilliancy to obtain incidences of 90° by the reflecting goniometer in every direction; the prism is also divisible parallel to both its diagonals, though not easily: fracture small conchoidal, and shining. Idocrase is mostly brownish- or yellowish-green, sometimes orange, rarely black; generally translucent, sometimes nearly transparent; possesses double refraction; is fusible with ebullition into a yellowish translucent globule, and forms with borax a diaphanous glass tinged green by iron.

1.



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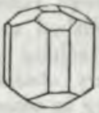

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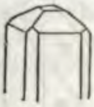

Fig. 1, the primary; a right prism with square bases. In fig. 2 the lateral edges of the prism are replaced by quadrangular planes, and a portion of the summit is replaced by four six-sided planes. In fig. 3 the quadrangular planes replacing the edges of the prism are very much increased, so as greatly to reduce the lateral primary planes.

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[*] Idocrase, in allusion to its form; a mixed figure, assuming that of other species. Vesuvian, from its having been first discovered on Vesuvius.

[†] The analysis of egeran by Borkowsky, gives the same formula. (See Beudant, Traité, t. ii., p. 67.) They thus agree with the formula for essonite and grossularite.

In the United States, at Chester, Mass., accompanying chabasie on mica slate, and with stilbite and chabasie on gneiss, at Hadlyme, Conn. In New Jersey, in trap rock, at Bound Brook and Patterson. On New York Island, in gneiss, and handsomely crystallized with yellow fasciculated stilbite, near Kipp's Bay; but the crystals from these last localities are small. At Jones Falls, near Baltimore, it is found in modified crystals similar to fig. 4, associated with stilbite and *Haydenite.* At Sackasunny, N. J. it also occurs in gneiss, in very brilliant crystals, with phosphate of lime.

The form of the most beautiful and brilliant secondary crystals, from Nova Scotia, is that represented by fig. 3. It is invariably the case that the replacements *f*, are smaller on the large crystals, in proportion to their other dimensions, than on the small ones, being sometimes barely perceptible to the eye. In the very smallest crystals the replacements *f*, have become so extended, as to reduce the length of the figure to nearly the same dimensions with its breadth, thus giving rise to what might appear, at first sight, a square prism terminated by low, obtuse, four-sided pyramids, resting upon the two opposite lateral faces of the crystal, as shown in fig. 4. As *a* and *a′* usually meet, these pyramids are very perfect.[*]

Fig. 3.

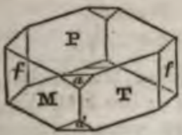
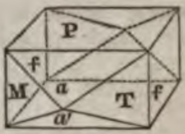


Fig. 4.



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[*] **Beaumontite.** (*M. Lévy. L'Institut*, 1839, No. 313, p. 455.) This is an exceedingly beautiful mineral, occurring in small brilliant pearly white crystals, the primary form of which, according to the determination of M. Lévy, is a Right square prism, M on M′ 130° 20′.[*] It has long been familiar to American mineralogists, as the associate of Haydenite found near Baltimore, Md.; and since, it has been supposed to be a new species, on the authority of M. Lévy, few American minerals have commanded greater interest. The demand for it has been but poorly supplied, owing to its extreme scarcity. This mineral proves, however, to be only a variety of Heulandite, under a new modification. On comparing its crystals with several of the forms of Heulandite from Nova Scotia, I was satisfied that they were all derived from the similar replacements of the acute lateral edges, and obtuse solid angles of the same primary Right oblique angled prism, as figured and described above. Crystals exhibiting every stage of these modifications were observed, but fig. 4, shows them under one of the not uncommon forms. On further comparing their hardness, and pyrognostic characters, and failing also to obtain any other cleavage than that well known in Heulandite, little doubt seemed to remain as to their identity. But to decide the point, I requested Mr. Teschemacher, to separate the best crystals from the specimens in my possession, and subject them to measurement by the reflecting goniometer, as I well know the public would have the fullest confidence in his use of that instrument. He informs me that P on M gives 90°, M on T 130°, M on *a* 143° 17′, P on *a* 111° 58′, and adds that he has no doubt the mineral is Heulandite. The variation in the third

[*] M. Levy's paper, which comprises also an account of Haydenite, was read before the French Academy of Sciences. An abstract of it may be seen in the Lond. and Edinb. Phil. Mag., Feb., 1840. p. 56, or Jour. of the Franklin Institute, Philad., vol. xxvi., new series, p. 155.

DAVYNE.

onticelli. (*Prodomo della Mineralog , Vesuv.*, p. 375.) Davytic Kouphone Spar, *Haidinger.* Var. Spatum hexagonum, D.

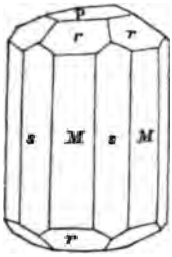
ntains, according to the analysis of Covelli, the follow-
stituents :

		Atoms.	Ratio.
Silica	42·97	21·45	6
Alumina	33·28	14·79	4
Lime	12·02	3·43	1
Water	7·43	6·60	2
Peroxide of iron	1·25		
Loss.	3·11		
	100·00		

us dividing the products by the atomic weights, as given
table, we obtain four atoms silicate of alumina, one
silicate of lime, and two atoms water. Formula: 4AlS
^{2}+2Aq. 5AlS, is given by Beudant.

Sp. Gr. 2·4. H. = 5·0 — 5·5.

r white or yellowish; transparent, translucent, or opake,
lustre inclining to opalescent in the first case, to pearly
pake; and the color to grey when transparent, — to
when opake. Cleavage perfect parallel to the planes
hexagonal prism, its primary form; fracture conchoidal.
rs in attached regular hexahedral prismatic crystals,
e lateral and terminal edges replaced, as shown in the
ng figure.



r on *r* contiguous . . 154° 46′
r on M 115 53

With nitric acid it effervesces and readily forms a jelly; and alone, B B, fuses with effervescence into a white, opake, and somewhat porous globule. Laminæ exposed to the flame of a candle do not lose their transparency. With boracic acid on platina wire, it affords a limpid colorless globule; and with salt of phosphorus in proper proportions, yields a pearly bead, which appears milky and opake when hot, but becomes translucent on cooling.

This mineral was described by Monticelli and Covelli, in their *Prodromo della Mineralogia Vesuviana*, and named by these mineralogists in honor of our illustrious countryman, Sir Humphrey Davy. It occurs in the more ancient rocks of Vesuvius, accompanying garnet, mica, wollastonite, &c. It may be distinguished from nepheline by the length of its crystals invariably exceeding their breadth, the reverse of which is the case in that mineral; its specific gravity is also much lower; and nepheline is not acted upon by acid as this is. (*Allan's Manual.*) It differs from nepheline also, in containing 12 per cent. of lime, and no trace of soda, of which Arfwedson found 20 per cent. in the former. It is classed with nepheline by some authors, but until the evidence of its identity with that species is undoubted, we shall not greatly err in allowing it to remain by itself, according to the determination of the authors above alluded to. The distinguishing characteristic of the two minerals is well shown by the formulæ.

LAUMONITE.*

Lomonit, W. Laumonite, H. Diatomous Kouphone Spar, M. Efflorescing Zeolite. Vulcanus Efflorescens, D.

Combination of silica, alumina, lime, and water.

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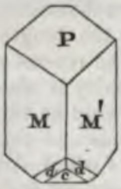
* In honor of Gillet de Laumont, by whom it was discovered in 1785.

	Huelgoet.		Skye.
Silica	48·3	49·0	52·04
Alumina	22·7	22·0	21·14
Lime	12·1	9·0	10·62
Water	16·0	17·5	14·92
Carbonic acid	0·0	2·5	0·00
	99·01 Gmelin.	100·00 Vogel.	98·72 Connell.

The mean of the two first analyses gives, when divided by the atomic weights, 3 atoms bisilicate of alumina, 1 atom bisilicate of lime, and 5 atoms water. Connell's differs only in an atom less of water, and thus comes very near to the first analysis. We shall therefore adopt the formula $3AlS^2+Cal^2+4Aq$.

Sp. Gr. 2·3. H. above 4.0 when fresh.

This mineral occurs in aggregated crystalline masses, deeply striated; or in separate crystals of several varieties of form, and sometimes in that of its primary crystal, — an oblique rhombic prism, of which the inclination of the terminal plane is from one acute angle to the other: this prism yields to cleavage parallel to its lateral planes and both diagonals. It is white, or yellowish white, sometimes with a tinge of red; and is transparent or translucent. B B, with borax it intumesces, and fuses into a colorless glass: *per se*, it first forms a white spumous enamel, and on continuing the heat, becomes translucent. It gelatinizes with nitric or muriatic acid.



M on M ——	86°	15′
P on M or M′	113	30
M or M on *c*	104	20

Laumonite was formerly termed the *efflorescent zeolite*, on account of its losing its water on exposure to the air; in consequence of which it becomes opake, of a shining white color, and pearly lustre; and eventually falls into a white powder, similar to that resulting from the decomposition of Glauber's salt.*

This mineral was first discovered in the lead mine of Huelgoet in Brittany, lining the cavities of the veins. It has since been found in trap in Iceland and Faroe; at St. Gothard; forming large masses, which exhibit a radiating and divergent structure, in the Fassa-thal, Tyrol; near Paisley in Renfrewshire; at the Kilpatrick Hills, Dumbartonshire; near Loch Enort in the Isle of Skye, accompanying stilbite; and at Port Rush in Ireland with analcime and stilbite in trap rocks. More recently it has been discovered in the amygdaloid of Nova Scotia, occupying oven-shaped cavities and hollow veins, as at Peter's Point and Sandy Cove, interspersed with calc-spar, apophyllite, stilbite, and specular iron.

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* The destruction of the specimens may be prevented, and, to some extent, the native transparency of the crystals retained, by immersing them in a thin solution of gum arabic; or they may be preserved unalterably in glass jars filled with alcohol, and hermetically sealed, in which they will be safe against the reduction of temperature, which might endanger the vessels if filled with water in the winter season. [AM. ED.]

In the United States it was early discovered by Professor Silliman, in the trap near New Haven, Ct. Fine specimens have been found in gneiss, on the banks of the Schuylkill, Pa., at Phillipstown, Putnam county, N. Y., with stilbite in felspar; also, in very perfect crystals, in the sienite of Charlestown, Mass., and in the gneiss of Phippsburg, Me. The last named locality has afforded the most magnificent crystals hitherto met with in the United States. They are associated with quartz and felspar in a drussy form; the whole forming a vein a foot thick, into the larger cavities of which implanted crystals of the laumonite are seen to project, often more than an inch in length, colorless and nearly transparent, and rarely replaced on the acute solid angles of the prism by single planes.

ZOISITE.[*]

Zoisit, W. Var. d'Epidote, H. Var. Augitus Rhomboideus, D.

Combination of silica, alumina, and lime, with a little protoxide of iron.

	Carinthia.	Bayreuth.	Carinthia.
Silica	45·0	40·25	39·03
Alumina	29·0	30·25	29·48
Lime	21·0	22·50	22·95
Protoxide of iron	3·0	4·50	6·48
Water	0·00	2·00	1·36
	98·00 Klaproth.	99·58 Bucholz.	99·58 Thomson.

Protoxide of iron and water being regarded as accidental, the formula deduced from these three analyses, and as given by Beudant and Dr. Thomson, is $2AlS+CalS$.

Sp. Gr. 3·2 to 3·3. H. = 6·0 — 7·0.

It occurs in oblique rhombic prisms, of a grey, greyish-yellow, or brown color, but which are rarely perfect, owing to deep longitudinal striæ: P on M unknown; M on M′ 116° 30′, according to Brooke. The obtuse lateral edges of the prism are often rounded, and the terminations incomplete. It also occurs massive, and cleaves parallel to the sides and both diagonals of the prism, but not with brilliant surfaces. It has a pearly lustre, and is translucent. Alone, B B, it fuses on the outer edges into a yellowish transparent glass, but finally into a vitreous scoria; with borax intumesces, and forms a diaphanous glass.

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[*] Zoisite, after the Baron de Zois.

It is met with in the Bucher Mountain and the Sau Alp in Styria, in a rock composed of kyanite, garnet, and augite; in granite in Bayreuth; also in Bavaria, Salzburg, the Tyrol, and the Vallais. It is mentioned by Jameson as occurring at Glenelg in Inverness-shire and in Shetland.

In the United States it is found at Wardsborough and Montpelier, Vt.; Milford, Ct.; Goshen and Williamsburg, Mass.

This species is by Mohs and others united with epidote, from which it principally differs in color, in atomic constitution, and, as it would appear, in crystalline form, but this latter has not, as yet, been fully determined.

EPIDOTE.*

Prismatoidal Augite Spar, M. Pistacit, W. Epidote, H. Thallite, *Karsten.* Delphinite. Augitus Rhomboideus, D.

Combination of silica, alumina, protoxide of iron, and lime.

	Pistazite. Isère.	*Crystallized Epidote.*	Isle St. John.	United States.
Silica	37·6	37·0	40·9	38·60
Alumina	27·0	21·0	28·9	26·15
Lime	14·0	15·0	16·2	28·84
Oxide of iron	17·0	24·0	14·0	10.56
Ox. of mangan	1·5	1·5	0·0	0·00
	96·5 Descotlis.	98·5 Vauquelin	100·00 Beudant.	99·05 Thomson.

In these analyses the proportion of silica varies but little, but there is a great variation in the other constituents. Beudant, adopting his own analysis and that of Descotlis, states the formula thus: $2\mathrm{AlS}+\underline{\mathrm{F}}\mathrm{S}$. He thus includes the lime with the iron. But the formula which shows the lime as an essential constituent would seem to express more truly the composition of this species; and the purest crystals which have been analyzed, give nearly an equal number of atoms of silica and bases — thus stated by Dr. Thomson: $4\mathrm{AlS}+3\mathrm{CalS}+2\underline{\mathrm{F}}\mathrm{S}$.

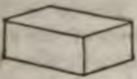
Sp. Gr. 3·42. H. = 6·0 — 7·0.

This mineral is found granular, massive, and in prismatic crystals, variously terminated and longitudinally striated. Color green of different shades, occasionally almost black, rarely brown or reddish. It has a shining lustre; and is somewhat transparent. The primary crystal is a right oblique-angled prism, of about 115° 30′ and 64° 30′; and it cleaves with brilliant surfaces, parallel to the sides and lesser diagonal of the prism.

B B, it intumesces, but does not, even by a strong heat, completely melt; with borax it intumesces, and then fuses into a glass colored by iron — unless manganese predominate, in which case it assumes, in the oxidating flame, an amethystine tinge.

According to Von Kobell, this and the preceding species swell and froth, fusing = 3 to 3½, into a blistered, cauliflower-like mass, or slag, which is white or yellowish with the first, and black or dark brown with the latter.

1



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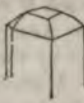

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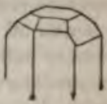
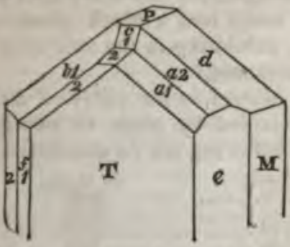


Fig. 1. The primary; a right prism, of which the bases are oblique-angled parallelograms. Of this there are several modifications, which commonly do not appear to have much direct affinity with the primitive: Fig. 2 exhibits one of the most simple.



M on T	115°	41′
P on M or T . .	90	—
M on *e*	150	15
T on *e*	145	24
— — *f* 1	145	39
— — *f* 2	114	40
M on *d*	125	2
P on *d*	145	6
— — *e* 1	148	30
T on *e* 1	121	50
— — *b* 1	104	30
— — *b* 2	142	35

Epidote is not often found massive, but chiefly in crystals, varying in size from the acicular to near an inch in diameter, and several inches in length; the acicular are met with in the department of Isère in France, at Bourg d'Oisans in Dauphiné, in the Alps, &c. (*Thallite* of Karsten.) The larger occur at Arendal in Norway, and Normark in Sweden (*Acanticonite* of Dandrada, or *Arendalite*): the magnificent crystals from these localities consist of concentric coats, the exterior of which admit of removal, and thus, out of a large imperfect crystal, one of smaller size, but more completely formed, may be produced with facility. It belongs chiefly to primitive rocks, but is only found in veins and fissures, among which, in small quantities, it occurs in many countries; magnetic iron, garnet, felspar, Adularia, axinite, and asbestus, are the minerals which chiefly accompany it.

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* From ἐπιδίδωμι, to increase; signifying that the base of the primary form undergoes an increase in some of the secondary forms.

he United States, crystals, resembling in size, color and
those from Norway and Sweden, occur in the iron mine
nconia, and Lisbon, N. H. Also a variety precisely
r to that from Piedmont, at Haddam, Ct., *Shepard.* At
ury, Athol, Rowe, and Nahant, Mass., finely crystallized:
former in the fissures of an amorphous garnet. — *J. W.*
er. At Lebanon, N. H., huge crystals are associated
and imbedded in Zoisite. — *C. T. Jackson.*

nular epidote. Scorza, Br. Appears from its analysis
epidote reduced to small grains by attrition. It occurs
banks of the river Arangos, near Muska in Transyl-
and is called *Scorza* by the inhabitants of the country.

nganesian epidote. Manganése oxydé silicifère, H. Epi-
iolet, Bt. Occurs in small prismatic crystals of a violet
ldish-brown color, which are generally associated in
, sometimes imbedded in asbestus. It is opake, and
to the knife; contains, by the analyses of Hartwell, 14
nt. of sesquioxide of manganese, which replaces protox-
iron. B B, it fuses easily into a black glass, — with
into a transparent one, exhibiting in the oxidizing flame
ethystine tinge of manganese.*

s variety occurs at St. Marcel, in the valley of Aosta, in
ont, in gneiss accompanied by oxide of manganese,
, asbestus, &c. The following are its constituents:

	St. Marcel.	St. Marcel.

	Dauphiné.		Trueburg.
Silica	50·50	44·0	45·80
Alumina	16.00	18 0	19·00
Lime	17·00	19·0	12·50
Protoxide of iron	9.50	14.0	12·25
Protoxide of manganese	5·25	4·0	9·00
Magnesia	0·00	0·0	0·25
Boracic acid	0·00	0·0	2·00
	98·05 Klaproth.	99·00 Vauquelin.	100·00 Wiegmann.

These analyses differ considerably from each other, and boracic acid was probably overlooked in the two first, though it is not regarded as an essential constituent. The last is much the latest, and has been adopted by Beudant and Dr. Thomson. If we calculate the atomic proportions of the constituents, we find the atoms of alumina nearly equal those of all the other bases; and hence supposing the boracic acid to be united with the lime and magnesia, the constitution of the mineral, as stated by Dr. Thomson, is 1 atom silicate of alumina and 1 atom bisilicates of the other bases. Formula: $\text{AlS}+(\text{Cal}+\underline{\text{F}}+\underline{\text{Mn}})\text{S}^2$. Beudant, who records the same formula, suggests that the boracic acid and silica may mutually replace each other.

Sp. Gr. 3·27. H. = 6·5 — 7·0.

This mineral rarely occurs massive, more frequently in flat oblique rhomboidal prisms, whose edges are remarkably sharp. It is harder than felspar, but is scratched by topaz. Common color violet or clove-brown, inclining to plum-blue and pearl-grey; also yellow and green, from an admixture of chlorite; occasionally nearly colorless, and transparent. The crystals do not appear to possess regular cleavages; their primary, therefore, has not been determined; their general form is that of a doubly oblique prism, which is assumed as the primary in the following figure. Externally the crystals are very brilliant; fracture small and conchoidal; becomes electric by exposure to heat; B B, intumesces and fuses readily into a dark green glass, which changes to black in the oxidating flame; with borax into a glass, also colored by iron; is not acted upon by acid. Fused with a mixture of fluor spar and bisulphate of potash, it communicates to the flame a transient green color.* Some varieties are differently electrified by heat, contiguous to opposite ends of the crystals, and in these also a difference has been observed by Haüy.

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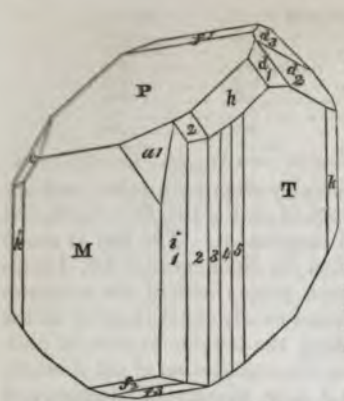
* See note to species Tourmaline.



P on M	134° 40′	M on *c*	112° 25′
P on T	115 17	— — *f* 2	135 12
M on T	135 10	— — *f* 3	90 18
M on *a*1	179 00	T on *k*	147 55
— — *a*2	150 3	— — *h*	152 5
— — *h*	146 35	— — *d*1	149 30
— — *d*1	130 30	— — *d*2	130 5
— — *d*2	100 45	— — *d*3	94 12
— — *d*3	72 38	P on *a*1	133 25
— — *i*1	179 20	— — *c*	136 22
— — *i*2	174 40	— — *f* 1	173 20
— — *i*3	152 25	— — *h*	143 20
— — *i*4	142 28	— — *d*1	139 30
— — *i*5	138 10	— — *d*2	121 30
— — *k*′	120 00	— — *d*3	110 20

It occurs in beds at Thum* in Saxony; at Barèges in the Pyrenees, upon a gangue of quartz; in splendid crystals, as remarkable for the brilliancy of their lustre as for their size and symmetry of form, at St. Christophe, near D'Oisans in Dauphiné; near Kongsberg in Norway, in a white laminated calcareous rock, accompanied by black mica, quartz, and native silver; at Arendal, with felspar, epidote, &c.; on mica slate in Savoy; in several places in the Hartz; and in killas at Botallack, near the Land's End, Cornwall, where it occurs both in well-defined though rather complex crystals, and massive and compact entering into the composition of a rock with tourmaline and garnet.

But one locality of this rare mineral is known to exist in the United States, a few crystals, precisely like those from Dauphiné, having been discovered by Dr. Jackson and the editor, accompanying the cinnamon-stone, &c., at Phippsburg, Maine.

ISOPYRE.†

Isopyric Quartz, *Haidinger*. Trachylite, *Breithaupt*. Hyalus Ferriferus, D.

Contains silica 47·09, alumina 13·91, peroxide of iron 20·07, lime 15·43, peroxide of copper 1·94.—*Turner*. The atomic constitution of this mineral, from the above analysis, rejecting the copper, is represented by this formula: $3AlS^2+2\underset{\cdot}{F}S^2+2CalS$.

Sp. Gr. 2·9—3·0. H. = 6·0—6·5.

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* Whence its designation of Thumite or Thumerstone.

† From ισος, equal, and πυϱ, fire; signifying that its behaviour, B B, is similar to that of several other species.

Occurs in compact masses of a velvet-black color, occasionally dotted with red, as in heliotrope. Opake, or faintly translucent on its thinnest edges, with a dark liver-brown tint. Brittle. Lustre vitreous. Cleavage not perceptible. Fracture flat conchoidal, highly perfect when the mineral is pure. Acts slightly on the magnetic needle. It fuses, B B, without emitting any gaseous matter. Acids act upon it with difficulty, but it is easily and completely decomposed by alkaline carbonates.

This mineral much resembles obsidian, but was distinguished by Haidinger[*] in consequence of its fainter and less vitreous lustre. It is perfectly black, and forms compact masses, occasionally two inches in diameter, in the granite of St. Just, near Penzance, where it occurs, associated with tin and tourmaline. Breithaupt's *trachylite* appears to be the same mineral; its specific gravity is stated somewhat lower, but in other respects it is identical; it forms small masses in basalt and wacke, at Säsebühl near Göttingen.

INDIANITE.

Bournon. (Phil. Trans., 1802, vol. ii.) Var. Spatum Vesuvianum, D.

		Rose-Red.	White.
Silica	42·5	42·0	43.0
Alumina	37·5	34·0	34·5
Lime	15·0	15·0	15·6
Oxide of iron	3·0	3·2	1·0
Soda	0·0	3·3	2·6
	98·0 Chenevix.	97·5 Laugier.	96·1 Laugier.

Sp. Gr. 2·74. Scratches glass.

In granular masses, of a white, greyish, and rarely rose-red color, with a shining lustre, sometimes tinged brown by a mixture of garnet. It is translucent. It cleaves, according to Brooke, into rhombic prisms of 95° 15′ and 84° 45′; is infusible B B, and, when digested in acids, becomes gelatinous. This substance was described by Bournon. It forms the gangue of corundum from the Carnatic;[†] and occurs associated with garnet, felspar, fibrolite, and hornblende.

The specific character of this mineral has not been well defined. Beudant supposes it to be a variety of labradorite. Laugier's analysis would seem to authorize its transfer from the earthy to the alkalino-earthy class.

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[*] Ed. New. Phil. Jour. 111. 263.

[†] Whence Indianite.

ANTHOPHYLLITE.*

Strahliger-Authophyllite, H. J. Prismatic Schiller Spar, M. Strelite. Augitus Phyllinus, D.

Combination of bisilicate of magnesia and bisilicate of iron.

Silica	56·74	56	57·12
Protoxide of iron	13·94	13	13·52
Magnesia	24·35	23	25·92
Protoxide of manganese	2·38	4	00·00
Lime	00·00	2	1·32
Alumina	00·00	3	trace
Water	00·00	00	1·36
	99·08 Vopelius.	101 Gmelin.	99·24 Thomson.†

The mean of these analyses gives 2 atoms of silica to 1 of bases, showing that the mineral is composed of bisilicates. The formula, as given by Dr. Thomson is $3\text{MgS}^2+\underline{\text{F}}\text{S}^2$.

Sp. Gr. 3·0 to 3·3. H. = 5·0 to 5·5.

Anthophyllite has a grey or clove-brown color; with an occasional blue tinge, and a glistening, pearly, pseudo-metallic lustre. It occurs massive, the mass consisting of crystals or crystalline fibres, often disposed in a radiating form: these may be cleaved parallel to the lateral planes of a rhombic prism of about 125° and 55° (73° 44′ and 106° 16′, according to Necker), and both its diagonals; the latter are not brilliant. The prism is generally traversed by natural crevices nearly at right angles to its axis; translucent on the edges. It is infusible B B, *per se;* with borax it melts with difficulty into a glass colored by iron; and with salt of phosphorus decomposes slowly, and yields a skeleton of silica.

It occurs at Konigsberg in Norway, with hornblende; translucent, and of a rich clove-brown color, at Ujordlersoak in Greenland; in foliated masses with mica, at Snarum, near Modum in Norway; in the United States associated with tourmalin, &c. in mica slate, at Haddam, Ct.; also in the same rock, at Chesterfield and Blanford, Mass.; at Richmond, N. H. in large bladed crystals, associated with iolite.

AMPHODELITE.

Nordenskiold. Berzelius, Jahresbericht, 1833, p. 174.

Contains silica 45·80, alumina 35·45, lime 10·15, magnesia 5·05, oxide of iron 1·70, water 1·85. The atoms of silica rather exceed those of the bases, but the mineral is described as consisting of simple silicates, expressed by this formula: $3\text{AlS}+(\tfrac{11}{21}\text{Cal}+\tfrac{8}{21}\text{Mg}+\tfrac{2}{21}\text{F})\text{S}$.

Sp. Gr. 2·76. H. = 4·5.

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* From its resemblance in color to the flower Anthophyllum.

† Localities of the two first specimens not known, and Dr. Thomson only tells us that his came from America.

Crystalline form, resembling that of felspar. Color light red; similar to scapolite in its fracture, and possessing two cleavages which meet at an angle of 94° 19′.

Occurs in the limestone quarry of Lojo in Finland.

ZEUXITE.*

Dr. Thomson. (Outlines of Mineralogy, &c., vol. i., p. 321.)

The composition of this mineral, which Dr. Thomson regards as a new species, is, according to his analysis, as follows:

Silica	33·480
Alumina	31·648
Protoxide of iron	26·010
Lime	2·456
Water	5·280
	99·074

Dr. Thomson observes that if we admit the atom of lime to be united with 1½ atom of protoxide of iron, in the state of sesquiferrite of lime, and to be accidental, this mineral will be a compound of 3 atoms silicate of alumina, 1 atom disilicate of iron, and 1 atom water. Formula: $3AlS+\underline{F}^2S+1Aq$.

Sp. Gr. 3·051. H. = 4·25.

Color brown with a slight shade of green, when we view a considerable mass of it together, but not perceptible in a single crystal. Composed of very small flat rectangular prisms interwoven in such a way as to leave cavities between them: from this structure the mineral may be called promiscuously fibrous. Lustre vitreous, glistening; opake. The crystals adhere to each other so loosely that the mineral is easily crumbled between the fingers. When heated in a glass tube it gives out water containing a trace of muriatic acid, and emits an odor which may be termed bituminous. By this treatment it loses rather more than 5 per cent. of its weight. B B, its color becomes deeper, and the crystals lose their edges and assume a scoriaceous appearance, but Dr. Thomson did not succeed in fusing them into a glass globule. With carbonate of soda it fuses easily into an opake bottle-green glass. With borax it effervesces and is converted into a dark brown glass, so very deep in the color that it appears opake.

It occurs in considerable quantity in the Huel Unity mine, Cornwall, and was first considered as a variety of actynolite.

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* So named because it occurs in the *united mines*, Cornwall.

BONSDORFITE.*

According to Bonsdorf's own analysis, this mineral is composed as follows;

Silica	45·05
Alumina	30·05
Magnesia, and a trace of oxide of manganese	9·00
Protoxide of iron	5·30
Water	10·60
	100·00

The formula, as given by Dr. Thomson, is: $3AlS(+\frac{3}{4}Mg+\frac{1}{4}F)S^2+2Aq$.

Sp. Gr. not given. H. = 3·5.

Color greenish brown or dark olive green. When viewed by transmitted light, thin lamellæ may be perceived, of a light greenish color. Occurs crystallized in regular six-sided prisms. In general the lateral edges are replaced by so many planes that the prism assumes nearly the appearance of a cylinder. Texture foliated; folia perpendicular to the axis of the prism; cross fracture conchoidal. Lustre of the faces like that of talc; of the cross fracture, waxy. Translucent when in thin plates; when in thick pieces, opake.

It occurs in red granite at Biskopsokern, near Obo, in Finland, and is accompanied by a black grey dichlorite and a greenish colored mineral, which Bonsdorf considers as a soda spodumene. The mineral is rarely found in our cabinets.

SMARAGDITE.†

Smaragdit, *Saussure.* Diallage vert, H. Diallage, J. Var. Augitus Protæus, D.

It contains silica 50, alumina 21, lime 13, magnesia 3, oxide of chrome and oxide of iron 13 — *Vauquelin.* Sp. Gr. 3·0.

Smaragdite has a brilliant or emerald-green color, and a silky or pearly lustre; is transparent on the edges, or opake; is scarcely so hard as glass, and yields to the knife; has a laminated structure, with cleavage parallel to the sides and diagonals of a slightly rhombic prism. It fuses into a grey or greenish enamel.

It is found massive, or disseminated in Saussurite, near Geneva, and on Monte Rosa in Switzerland; also in Corsica imbedded in felspar. Haidinger considers it to be a compound of laminæ of hornblende, alternating with laminæ of augite, both frequently of bright-green colors. (Vol. x. of *Edinburgh Royal Society Transactions.*)

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* Named by Dr. Thomson, in honor of Von Bonsdorf. (See Outlines of Mineralogy, &c., vol. i., p. 324.)

† From the Greek, signifying a green stone — an emerald.

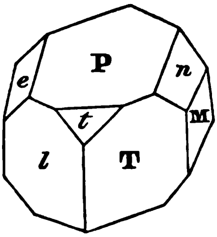
ANORTHITE.*

Anorthotomous Feldspar, M. Christianite, *Monticelli.* Anorthite, *Rose.* Spatum Vesuvianum, D.

Combination of silica, alumina, lime, magnesia, and oxide of iron. Silica 44·49, alumina 34·46, lime 15·68, magnesia 5·26, oxide of iron 0·74 — *Rose.* By dividing these products by the atomic weights, we find that the number of atoms of silica nearly corresponds with those of the bases, showing that the mineral is composed of simple silicates, and approaches this formula: $7\mathrm{AlS}+2\mathrm{CalS}+\mathrm{MgS}$. Beudant, calculating from the quantities of oxygen, makes the first term 8, instead of 7.

Sp. Gr. 2·65. H. $=$ 6·0.

Primary form a doubly oblique prism. Cleavage perfect parallel to P and M. Occurs in white, translucent or transparent crystals, which present a vitreous lustre, inclining to pearly on the planes of cleavage; fracture conchoidal; streak white. Is entirely decomposed in concentrated muriatic acid. B B, on charcoal, it assumes first a vitreous and translucent aspect, and then fuses with difficulty on the edges into a blebby and semi-transparent glass; with salt of phosphorus is decomposed, with the exception of a silica skeleton, and yields a glass which becomes opaline on cooling.



M on P	94° 12′
M on T	117 28
P on T	110 57
M on *l*	117 25
T on *l*	120 30
P on *e*	137 32
P on *n*	133 13
P on *t*	138 46†

This species was simultaneously described by Prof. G. Rose under the title of anorthite, and by Monticelli under the denomination of Christianite.‡ Its principal locality is Vesuvius, or rather Monte Somma, the ancient crater of that volcano; it generally occupies the cavities of chloritic masses, and is associated with ice-spar, augite, mica, and idocrase. Its difficult fusibility B B, serves to distinguish this mineral from any of the zeolites, as well as from nepheline and leucite. It was separated from felspar, with which it had been confounded, by Professor G. Rose.

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* From ανοϱθος, oblique, because the interfacial angles of the crystals are oblique.

† The above figure and measurements have been taken from Shepard's Mineralogy. [Am. Ed.]

‡ In compliment to Prince Christian of Denmark.

CLAYS.

Thon, W. Argile, H.

The substances comprehended in the term Clay admit of no general description, but most of them agree in possessing an earthy texture, and emit an argillaceous odor when breathed on. They consist chiefly of silica, with a variable proportion of alumina, and a small quantity of lime or magnesia, occasionally of alkali. They are of various degrees of hardness, sometimes quite compact, and even of a slaty structure. As they never occur crystallized, and are evidently mechanical mixtures, frequently derived from the decomposition of other materials, they cannot properly be regarded as formularic minerals of constant proportions of ingredients.

1. Slate-clay. Shale. Schieferthon, W. Argile schisteuse, Br. Shale occurs only massive; its general color is grey, which sometimes is bluish, yellowish, or blackish; in one direction its structure is slaty, in the other earthy; it is easily broken; it usually adheres to the tongue, and yields to the nail; is opake, meagre to the touch, and dull, except from casually imbedded mica, which sometimes imparts a glimmering lustre: its specific gravity is about 2·6. It is found resting upon, as well as interposed between, beds of coal, which it invariably accompanies. It often contains impressions of reeds and of ferns.

Black Bituminous Shale has a slaty structure; when put into the fire, it blazes, crackles, and emits a black smoke and bituminous odor, loses a considerable portion of its weight, and is converted into a whitish or reddish flaky ash. It is found in common coal, being generally more or less mixed with it.

Brown Bituminous Shale is met with at Kimmeridge, in Hampshire; and from its giving out a bituminous odor, when placed in the flame of a candle, or in the fire, is termed *Kimmeridge-coal.* Its color is greyish brown; it has a somewhat slaty texture, and occasionally a large flat conchoidal fracture: it yields easily to the knife, and acquires lustre by the pressure of the nail. On exposure to a considerable heat, the bituminous part is consumed, and it is reduced to a grey earthy ash.

Rottenstone. Its color is dirty grey, or reddish brown, passing into black: it is dull, earthy, soft, meagre to the touch, and emits an unpleasant odor when rubbed. According to the analysis of R. Phillips, it consists of 86 alumina, 4 silica, and 10 carbon. Occurs at Bakewell in Derbyshire, and is believed to arise from the decomposition of the shale of that country.

2. ADHESIVE SLATE. Schiste à polir, Br. Adhesive slate, J. Contains silica 86·50, alumina 7·00, magnesia 1·50, lime 1·25, oxide of iron 2·50 — *Klaproth.* Is found massive, and possesses a slaty texture, which becomes visible by exposure; but if the mass be immersed in water, it resumes its former appearance. Has a yellowish or smoke-grey color; is very soft, splits easily, adheres strongly to the tongue (whence *Adhesive* slate), and is opake. Its specific gravity is 2·08; and it is infusible B B. On exposure to a red heat, it becomes brownish, and loses weight. It absorbs water with avidity, but does not fall to pieces. It has hitherto been found only in the gypsum formation around Paris, and is the imbedding substance of the Menilite.

3. POLISHING SLATE. Polier schiefer, W. Sp. Gr. 0·59 — 0·60. Is of a white, yellowish-white, or yellow color; massive, with a slaty texture; is opake, brittle, and so light as to swim on water. One variety yielded to Bucholz, silica 83·50, alumina 4·0, lime 8·50, oxide of iron 1·60, water 9·0. It imbibes water, and when burnt becomes red, but does not fuse. It is found near Bilin in Bohemia, in a bed resting on marl; also at Zwickau in Saxony, and in Auvergne, and is supposed to be a volcanic production. It is used for polishing glass, marble, and metals.

4. LITHOMARGE. Steinmark, W. Argile lithomarge, H. Sp. Gr. 2·43. Is yellowish or reddish-white; also grey or bluish, and is frequently spotted internally. It is massive; soft; adheres strongly to the tongue; has a greasy feel; gives a shining streak, and is commonly opake, occasionally translucent; texture earthy, but has a large conchoidal fracture. It is infusible B B; sometimes phosphoresces when heated, and hardens if exposed to a high temperature. It occurs at Ehrenfriedersdorf and Altenburg in Saxony; at Planitz, near Zwickau in Bohemia; and has been noticed in small quantities in the tin and copper veins of Tin Croft and Cook's Kitchen mines near Redruth, which traverse both granite and schiste.

In the United States it has been found in Maryland, at the Bare Hills, near Baltimore; also in Montgomery County, Pa.: in both instances in serpentine. — *Cleaveland.*

Friable Lithomarge, in scaly, glimmering particles, which are phosphorescent in the dark, occurs in the tin veins of Ehrenfriedersdorf in Saxony, and some other places. Klaproth found it to consist of silica 32, alumina 26·50, iron 21, water 17, and muriate of soda 1·50.

5. Fuller's Earth. Walkerde, W. Argile smectique, H. Sp. Gr. 1·82 to 2·19. Occurs massive, and is usually of a greenish-brown color, sometimes nearly that of slate; it is opake, soft, dull, possesses an earthy fracture and a greasy feel, and yields to and receives a polish from the nail, but scarcely adheres to the tongue; in water it becomes translucent, and falls into a pulpy impalpable powder. A variety from England yielded 53 silica, 10 alumina, 0·5 lime, 1·25 magnesia, 9·5 oxide of iron, 1 muriate of soda, and 24 water. It is fusible into a porous slag, and ultimately forms a white blebby glass.

At Nutfield near Riegate, in Surrey, it occurs in regular beds near the summit of a hill of considerable elevation, between beds of sand or sandstone containing fossil wood and impressions of the nautilus and other sea-shells. There are two distinct beds of fuller's earth; the upper, of a greenish clay color and five feet in thickness, rests upon the other, which is of a light slate-blue, and eleven feet thick; in these beds, but principally in the latter, are found considerable masses of sulphate of barytes, sometimes exhibiting regular crystallizations. Fuller's earth is also found at Deptling, near Maidstone in Kent; and at Apsley, near Woburn in Bedfordshire, under nearly the same circumstances as at Nutfield. Also at Old Down near Bath; near Nottingham; in Sussex; and at Rosswein in Saxony. It occurs among primitive rocks, and is supposed to originate from their decomposition. From its property of absorbing oil and greasy matter, this substance was formerly much used in the fulling of cloth (whence its name), and was forbidden to be exported under severe penalties: soap is now generally substituted.

6. Tripoli. Tripel, W. Quarz aluminifère Tripoléen, H. Sp. Gr. 1·86—2·2. This mineral has generally an argillaceous aspect. It occurs massive, with a coarse, dull, earthy fracture; it is meagre and rough to the touch, does not adhere to the tongue, and yields easily to the nail. Presents various shades of grey, yellow, and red; and yielded to Haase 90 silica, 7·0 alumina, and 3·0 iron. It imbibes water, which softens it; when burnt, becomes white and is hardened; but is very difficultly fusible. It was first brought from Tripoli in Africa, but has since been noticed in the Puy de Dome, in Tuscany, near Prague, at Arnberg in Bohemia, and many other places;

and appears to be merely a fine arenaceous variety of quartz, accidentally mixed with clay. It is used in polishing metals, marble, glass, and other hard bodies.

7. **Bole.** Bol, W. Bole, J. Sp. Gr. 1·60—1·97. Bole occurs in solid amorphous masses of a yellow, red, or brownish-black color. The yellow is translucent on the edges, the red is nearly translucent, and the brownish-black opake. It yields to the nail, exhibits a conchoidal fracture, gives a shining streak, adheres to the tongue, has a greasy feel, and fuses into a slag. Immersed in water, it emits a crackling noise, and breaks in pieces.

This substance is found in irregular beds or disseminated masses in wacke and basalt, from the decomposition of which it is supposed to arise. It occurs at Striegau in Silesia, at the Habichtswald in Hessia, and near Sienna in Italy.

8. **Lemnian Earth** is yellowish-grey, or white, frequently with ochreous spots on the surface. The fracture is earthy; dull; has a meagre feel; adheres slightly to the tongue; and, when immersed in water, falls to pieces, evolving numerous air-bubbles. Klaproth found it to consist of silica 66, alumina 14·50, oxide of iron 6, water 8·50, together with very minute portions of lime and magnesia, and 3·50 of soda.

It is dug once a year with much ceremony in the Isle of Lemnos,[*] in the Mediterranean, where only it is found. It was formerly used in medicine.

9. **Cimolite** is of a light greyish-white, inclining to pearl-grey, but by exposure it acquires a reddish tint; it occurs massive, and exhibits a somewhat slaty texture; is opake, dull, and has an earthy fracture; yields to the nail, and adheres to the tongue. It often encloses small grains of quartz. It consists of 63 silica, 23 alumina, 1·25 oxide of iron, and 12 water. Sp. Gr. 2. It is infusible.

It abounds in the island of Cimola,[*] now called Argenteria, situated near that of Milo. It was employed by the ancients, and still is by the inhabitants of the island, for some of the purposes to which fuller's earth is applied.

10. **Mountain-Meal.** Bergmehl.—*Fabbroni.* This singular mineral was found in the form of a bed by Fabbroni, at Santa Fiora, between Tuscany and the Papal dominions; it is manufactured into bricks so light as to swim on water. It consists of silica 79, alumina 5, oxide of iron 3, water 12.—***Klaproth.***

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[*] Whence Lemnian earth.

[†] Whence Cimolite.

11. **Black Chalk.** Zeichenschiefer, W. Argile schisteuse graphique, H. Schiste à dessiner, Br. Amphelite graphique, Bt. This mineral is greyish or bluish-black; has a slaty texture; is meagre to the touch, and soils the fingers. Exposed to heat it becomes red. It is found in primitive mountains, accompanying argillaceous schiste, particularly the aluminous, to which it is nearly allied. It is met with in France, Spain, Italy, and in Bayreuth. It is used both in drawing and painting; its streak on paper is quite black. The variety from Bayreuth contains silica 64·50, alumina 11·25, oxide of iron 2·75, carbon 11·00, water 7·50. — *Wiegleb.* Sp. Gr. 2·11 — 2·18.

12. **Pipe-Clay.** Has a greyish or yellowish-white color; an earthy fracture, and smooth greasy feel; it adheres pretty strongly to the tongue, is very plastic and tenacious, and is infusible. It is manufactured into tobacco-pipes, and is the basis of the queen's-ware pottery. An extensive stratum of pipe-clay lies in a horizontal position above the chalk, extending from Handfast Point to beyond Corfe Castle in Dorsetshire. It may be traced in the hills near Poole, and is found in many parts of that extensive tract called the Trough of Poole.

Pipe clay is found at various places in the United States, but very abundantly in the eocene tertiary formation of Martha's Vineyard, Mass., where it is mixed with coarser varieties of various shades, and forms high cliffs upon the seashore.

13. **Potter's Clay** is plastic, and disintegrates by exposure. It is generally of a reddish, bluish, or greenish color, and has a soft and often greasy feel. When mixed with sand, it is made into bricks and tiles. A variety found in the forest of Dreux in France (employed, on account of its infusibility, in the making of tiles for the porcelain furnaces) consists of 43 silica, 33 alumina, 3 lime, 1 iron, and 18 water. Most of the clay used in the Staffordshire potteries is brought from Devonshire.

Potter's clay is found abundantly at South Amboy, N. J., and is employed in the manufacture of stone ware and fire bricks.

PYROPHYLLITE.[*]

Hermann of Moscow. (*Poggendorf's Annalen*, xv. p. 592.)

Silica 59·79, alumina 29·46, magnesia 4·0, oxide of iron 1·8, water 5·62. — *Hermann.* Formula, as given by Dr. Thomson: $8AlS^2+MgS^2+3Aq$.

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[*] From πυρ, fire, and φυλλον, a leaf.

Sp. Gr. 2·8. H. = 1·5.

Occurs in fibrous radiating masses, and small elongated prisms, sometimes with terminations, but whose form is nevertheless not ascertained. Of a light green color; lustre pearly; in thin laminæ, transparent. This mineral used to be considered a radiated variety of talc, but its comportment, B B, is peculiar. Heated *per se*, it exfoliates into white leaves, and increases to about twenty times its original size, but does not fuse. With borax it forms a green transparent glass, which on cooling loses its color; with salt of phosphorus is decomposed into a colorless glass and a skeleton of silica; with soda fuses with effervescence into a transparent yellow glass; and heated with a solution of cobalt, it assumes a blue tinge.

It occurs near Beresof in the Ural Mountains of Siberia.

FAHLUNITE.

Triclasite, H. Peritomous Petaline-Spar, *Shepard.* Stylus Acrotomus, D. Fahlunite, *Hisinger.*

Combination of silica, alumina, and water, mixed with magnesia, potash, soda, oxide of iron, and manganese.

	Tricklasite.	Green variety.	Black variety.	Grey variety.
Silica	46·79	44·95	43·51	44·60
Alumina	26·73	30·70	25·81	30·10
Magnesia	2·97	6·04	6·35	6·75
Protoxide of iron	5·01	7·22	6·35	2·24
Oxide of manganese	0·43	1·90	0·00	0·00
Potash and soda	0·00	1·38	5·39	1·98
Water	13·50	8·65	11·66	9·35
	95·43 Hisinger.	100·84 Wächt'r.	99·07 Wächt'r.	95·02 W'r.

From the mean of the three last analyses by Wächtmeister, Dr. Thomson states the formula thus: $3\text{AlS}+(\frac{6}{10}\text{Mg}+\frac{3}{10}\text{F}+\frac{1}{10}\text{Mn})\text{S}^2+2\text{Aq}$. The silicates of potash, soda, and lime are regarded as accidental.

Sp. Gr. 2·6—2·7. H. = 3·0.

Primary form an oblique rhombic prism of 109° 28′ and 70° 32′. Occurs massive and in six-sided prisms; the crystals, however, from their highly perfect cleavage, almost invariably fracture in parallel position with the slate in which they occur, and thus present only sections of their form. Cleavage perpendicular to the axis of the prism; lustre resinous. B B, it becoms grey, and fuses on its thinnest edges; but with borax melts slowly into a glass slightly colored by iron. Color dark reddish-brown; occasionally green or black, and opake; but when reduced to small fragments, translucent, and yellowish-brown by transmitted light. It occurs imbedded in chlorite slate in a copper mine at Erie Matts, Fahlun, Sweden; whence its name by Hisinger, who first described it.

IOLITE.*

Dichroite, *Cordier.* **Cordierite,** *Leonhard.* **Prismatic Quartz, M. Iolite, H. Hyalus Bicolor, D.**

Combination of silica, alumina, magnesia, oxide of iron, and manganese.

	Simitok.	Bodenmais.	Orijerfwi.	Fahlun.
Silica	49·17	48·35	49·95	50·24
Alumina	33·10	31·70	32·88	33 42
Magnesia	11·48	10·15	10·45	10·84
Protoxide of iron	4·33	8·31	5·00	4·00
Protoxide of manganese	0.00	0·33	0·03	0·68
Water	1·20	0·59	1·75	1 66
	99·28 Strom.	99·43 Strom.	100·06 Bons.	100·84 Strom.

	Steinhillite.	Haddam, Ct.	Richmond, N.H.	Unity, N.H.
Silica	48·525	48·35	48·00	48·15
Alumina	31·502	32·50	35·00	32·50
Magnesia	00·000	10·00	10·00	10·14
Protoxide of iron	15·000	6 00	6·00	7·92
Protoxide of manganese	1·510	0·10	1·00	0.28
Water	0·243	3·10	0·00	0·50
	98·305 Thomson	100·05 Jackson	100·00 Jackson	99·49 Jackson

It will be observed that there is a remarkable agreement among these several analyses, both as regards the foreign and American specimens. In the analysis of the Haddam specimen, by Dr. Jackson,† the water amounts to one atom. If this is considered as accidental, the atomic constitution calculated from each of the analyses above recorded, will agree with the formula given by Beudant, in which the oxides of manganese and iron are included with the magnesia. $3AlS+MgS^2$.

Dr. Thomson includes the manganese with the iron, which together make one atom silicate of iron, and this he adds to his formula.

Sp. Gr. 2·56. H. = 7·0 — 7·5.

This mineral has a dark-blue color, sometimes with a tinge of black; but when viewed by transmitted light at right angles to the axis of the prism, it appears brownish yellow. It occurs massive, and crystallized in six or twelve-sided prisms; its primary being the six-sided prism. Transparent or translucent; with a shining vitreous lustre, and an uneven and somewhat conchoidal fracture. Alone, B B, in a strong heat, fuses on the edges = 5 to 5½, into a bluish glass; with borax it melts slowly into a diaphanous glass. Not affected by acid.

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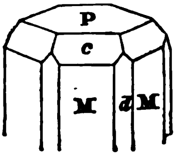
[*] Iolite, from its bluish violet color in one direction.

[†] For the last analyses I am indebted to Dr. C. T. Jackson, who kindly furnished them to me from his private manuscript, before they had been published in any other work. [Am. Ed.]



P on M or M . .	90° 00′
M on M	120 00
M on M or *d* . . .	150 00
M on *c*	137 46

It is found at Cape de Gatte in Spain, imbedded in granite; in very large individuals imbedded in quartz at Ujordlersoak and Simitok, in Greenland; and in distinct crystals, with magnetic pyrites, at Bodenmais, in Bavaria. It is more common massive, being found in that state among the primitive rocks of Arendal in Norway, Orijerfwi in Finland, &c. In the United States it occurs in gneiss at Haddam, Ct., associated with garnet and anthophyllite. It is transparent, of various shades of blue and green, and possessed of dichorism. Larger specimens have recently been discovered in opening for the railroad near Shetucket River, in the same State, and where it is imbedded in quartz, and accompanied by blood-red garnet. — *Shepard's Report*, p. 139.

Iolite of a fine delicate sapphire-blue color, like that from Bodenmais, occurs at Richmond, N. H., near the Soapstone Quarry. It is in regular six-sided prisms, and also in broad laminated masses, occasionally as large as the palm of the hand. It is associated with large bladed crystals of anthophyllite, and occurs also in veins of white quartz, accompanied by phosphate of lime and pinite. At this locality it does not pass into the hydrous iolite, or chlorophyllite, as is the case at Unity, N. H., where specimens of equal beauty have been obtained. For the discovery of these two very interesting localities we are indebted to Dr. Jackson.

1. **Peliom** * is a name occasionally given to the Bodenmais variety, which, from its containing a larger portion of iron, is somewhat heavier.

2. **Dichroite.** This mineral received its name from δις, double, and χρόα, color, alluding to its property of exhibiting different colors, depending upon the position in which it is held.

3. **Steinheilite**, named after Count Steinheil, refers to that from Finland. The varieties, however, are perfectly identical with iolite.

4. The **Hard Fahlunite** of Berzelius, from Fahlun in Sweden, is merely a brownish-yellow variety of this species, which

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* From the Greek, signifying bluish color or blackish

s its peculiar color and opacity from accidental admix-
In other respects it is similar. The *Sapphire d'eau* of
rs is a transparent iolite from Ceylon.

HYDROUS IOLITE. *Bonsdorf.**

Chlorophyllite.† C. T. Jackson.

s differs from the preceding species in hardness, specific
, and other physical properties, besides being a hydrated
l. We are indebted to Bonsdorf for the first description
alysis of it, distinguishing it from common iolite. Its
cality has been in the neighborhood of Abo, where it is
panied by a light bluish-grey iolite. But it has recently
iscovered in the United States by Dr. Jackson, at Unity,
very plentifully in amphibole rocks, where it is also ac-
nied, as at Abo, by common iolite, into which it ulti-
passes. The composition of the mineral, from both
es, is shown by the following analyses :

	Abo.	Unity.
Silica	45·05	45·20
Alumina	30·05	27·60
Magnesia	9·00	9·60
Protoxide of iron	5·30	8·24
Protoxide of manganese	00·00	4·08
Water	10·60	3·60
Trace of phosph. acid and loss	00·00	1·68
	100·00 Bonsdorf.	100·00 C. T. Jackson.

ding by the atomic weights, the first analysis gives an
of atoms of base over those of silica, and as stated by

talcy lustre. Cross fracture conchoidal. Cleavage surfaces brilliant. Heated in a glass tube they alike give out pure water, but undergo no other alteration. They cannot be fused, B B, *per se;* that from Unity slightly glazes on the surface; with carbonate of soda fuses with slow effervescence, and forms an opake-greenish enamel, which becomes of a darker green in the reducing flame. The surface specimens of the latter are so soft that they may easily be cut with the knife, though they are not in the least decomposed, while those obtained from the interior of the rock approach the hardness of common iolite.

SORDAWALITE.

Nordenskiöld's Bidrag, p. 86.

Contains silica 49·40, alumina 13·80, peroxide of iron 18·17, magnesia 10·67, phosphoric acid 2·68, water 4·38. — *Nordenskiöld.*

Formula by Beudant: $3AlS^2+3(F,Mg)S^2+2Aq$.

Sp. Gr. 2·53 — 2·58. H. = 2·5 — 3·0.

Occurs in opake, greyish or bluish-black colored masses, which do not exhibit traces of cleavage; lustre vitreous; fracture conchoidal; streak liver brown; brittle. B B, *per se,* it fuses with difficulty into a dark-colored globule, and with borax forms a green glass; with a small quantity of soda it yields a blackish-green globule, and with a larger quantity a rough slaggy mass. It is partly soluble in muriatic acid, and becomes red on exposure to the atmosphere.

This mineral was discovered and analyzed by Nordenskiöld, who found it near the town of Sordawala in Finland, forming thin layers in a primitive rock. It occurs also with magnetic pyrites at Bodenmais in Bavaria. It resembles pit coal in appearance.

HARMOTOME.*

Kreuzstein, W. Harmotome, H. Pierre Cruciforme, Br. Cross-stone, J. Paratomous Kouphone Spar, M. Andreolite. Ercinite. Vulcanus Gemellus, D.

Composed essentially of silica, alumina, barytes and water, as shown by the best analyses hitherto made.

	Schiffenburg.	Andreasberg.	
Silica	44·79	46·62	48·74
Alumina	19·28	16·82	17·65
Barytes	17·59	20·32	19·22
Lime	1·08	0·26	00·00
Soda or potash	0·00	1·02	00·00
Water	15·32	15·03	14·66
	98·07 Wernekinck.	100·07 Kohler.	100·27 Rammelsberg.

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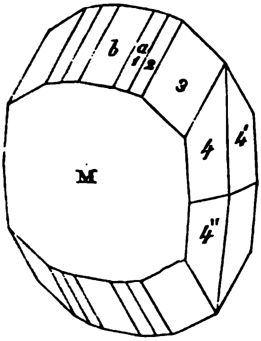
* From ἁρμος, a joint, and τεμνω, I cut. Because it admits of cleavage at the joints.

	Oberstein.	Oberstein.	Strontian.	Strontian.
	46·65	47·5	47·04	48·75
	16 54	19·5	15·24	15·01
	19·12	16·0	20·85	14 27
	1·10	00·0	0·10	3·18
tash	1·10	00·0	0·88	2·55
	15·24	13·5	14·92	14·00
	99·75 Kohler.	96·5 Tassaert.	100·11 Connell.	97·85 Thomson.

atomic constitution of harmotome, as given by Dr.
on, from the mean of the last three analyses, is 4 atoms
ate of alumina, 1 atom tersilicate of barytes, and 6 atoms
r. Formula: $4AlS^3+BS^3+6Aq$. Beudant gives a for-
or each analysis in his *Traité élémentaire*, and in his late
Cours élémentaire de Minéralogie), he states the con-
ts only, without giving their atomic proportions, evident-
rding its constitution as doubtful. But the formula
by Berzelius, accords with that above stated, with the
difference only of BS^4, instead of BS^3.*

Sp. Gr. 2·35 — 2·4. H. = 4·5.

notome sometimes occurs in flattish quadrangular prisms,
ated by rhombic planes, replacing the solid angles of the
these crystals often cross each other lengthwise and at
ngles, so that their axes coincide. The crystals yield
vage parallel to the planes and both diagonals of a right
gular prism, which is the primary form. The usual color
mineral is greyish white; it is translucent, and has a
hat pearly lustre. B B, it fuses easily, without intumes-



M on *b*	125°	5'
b on *b* over summit	110	26
b on *a* 1	171	4
b on *a* 2	151	35
b on *a* 3	149	32
a 4 on *a* 4' or *a* 4 on *a* 4''	177	28

Strontian, in Argyleshire, produces the finest specimens of the simple crystal; while the cruciform varieties are best known in metalliferous veins, traversing grauwacke, at Andreasberg in the Hartz. It is also met with in the trap rocks of Kilpatrick Hills, Dumbartonshire, accompanying analcime; on gneiss at Kongsberg in Norway; and in the cavities of siliceous geodes at Oberstein in Deuxponts.

MORVENITE.

Since the mineral from Aci Reale, in Sicily, once classed with harmotome, has been made into a new species by the late M. Levy (see Phillipsite, or lime-harmotome), Dr. Thomson has analyzed some transparent crystals from Strontian, having precisely the same measurements with harmotome, but differing from it in chemical constitution, and in other characters, which he also makes into a new species, under the name of MORVENITE. He states its composition thus:

Silica	64·755
Alumina	13·425
Lime	4·160
Protoxide of iron	2·595
Water	14·470
	99·405

Formula being $5AlS^4+CalS^4+11Aq$. Of this mineral Dr. Thomson observes that the appearance of its crystals is quite different from that of any other crystal of harmotome hitherto examined; and if to this be added its transparency, its greater specific gravity, and the very great difference in its composition, we cannot hesitate to consider it entitled to rank as a distinct species. (*Outlines of Mineralogy*, i. 352.)

BREWSTERITE.*

, *Brooke.* Brewsteritic Kouphone Spar, *Haidinger.* Vulcanus Brewsterianus, *D.*

bination of silica, alumina, strontia, baryta, lime, and with a little oxide of iron.

	Strontian.	Strontian.
Silica	52·040	53·045
Alumina	15·918	16·540
Barytes	5·827	6·050
Strontian	7 709	9·005
Lime	1·007	0·800
Peroxide of iron	0·208	0·000
Water	12.584	14·735
	95·653 Connell.	100·175 Thomson.

specimen analyzed by Connell was a portion of an ous and crystallized mass, while that selected by Dr. on consisted of very perfect and pure crystals; yet a remarkable agreement between them. Calculating nic proportions from his analysis, and admitting a little e of lime to be accidental, Dr. Thomson has thus he formula: $3AlS^3+(\frac{1}{3}Br+\frac{2}{3}Str)S^3+6\frac{1}{2}Aq$. It thus rom Heulandite in having tersilicate of barytes and n in place of tersilicate of lime, and also in containing atom more of water.

Sp. Gr. 2·1 — 2·4. H. = 5·0 — 5·5.

Brewsterite was first observed at Strontian in Argyleshire, where it generally occurs associated with calcareous spar; but has latterly also been met with, coating the cavities of amygdaloidal rocks at the Giant's Causeway; in the lead mines of St. Turpet, near Freiburg in the Brisgau; in the department of Isère in France; and in the Pyrenees. *(Allan's Manual.)*

We are indebted to a distinguished analyst, Arthur Connell, Esq., of Edinburgh, for the first correct analysis of this mineral, and the discovery of both barytes and strontian, as essential constituents of it.

TABULAR SPAR.

Prismatic Augite Spar, M. Wollastonite, *Necker.* H. Schaalstein. W. Spath en Tables, H. Bisilicate of Lime, Thomson. Table Spar. Grammite. Augitus tabularis, D.

Combination of silica and lime.

	Cziklowa.	Cziklowa.	Pargas.	Perheniémi.
Silica	51·44	53·1	52·58	51·60
Lime	47·41	45·1	44·15	46·41
Magnesia	0·00	1·8	0·68	0·00
Protoxide of iron	0·40	0·0	1·13	traces
	99·25 Strom.	100·0 Beudant.	98·84 Bonsd.	98·01 H. Rose.

		Willsborough, N. Y.		Buck's county, Penn.
Silica	51·71	51.67	51·00	51·50
Lime	43·35	47·00	46·00	44·10
Protoxide of iron	1·90	1·35	1·30	1·00
Water	3·20	0·00	1·00	0 75
	99·96 Thomson.	100.02 Vanuxem.*	99.30 Seybert.†	97.35 Prof. Morton.‡

Each of the above analyses gives very nearly two atoms of silica to one of lime. From the mean numbers of the last four, we obtain 25·74 atoms silica, and 12·88 atoms lime, or almost *exactly* two atoms of acid to one of base. The mineral is therefore a bisilicate, and is represented by this formula: $CalS^2$.

Sp. Gr. 2·86. H. = 4·5 — 5·0.

Tabular spar generally occurs in fibrous masses of a greyish-, yellowish-, greenish-, or reddish-white color: with a shining and somewhat pearly lustre; translucent; often friable. Primary form, according to Brooke, an oblique rhombic prism. P on M 104° 48′; M on M 95° 38′. Cleavages are easily obtained parallel to the planes M M, of the primary. It is phosphorescent when scratched with the knife, as well as when heated. A fragment placed in nitric acid effervesces quickly at first, and then falls into powder. On charcoal it melts on the edge into a semi-transparent colorless glass, but requires a very strong heat for its perfect fusion; with borax it melts easily into a colorless transparent glass.

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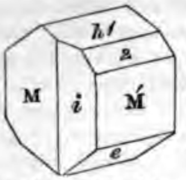
* Journal of the Academy of Natural Sciences, Phila., vol. ii. p 184.

† American Journal of Science, iv. 320. ‡ Ann. of Phil., 127. p. 46.

y form.



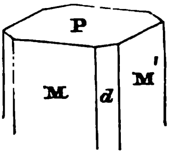
M on M'	95°	20'
M on *i*	139	45
M' on *i*	135	30
M on *h* 1	93	40
M' on *h* 1	126	00
h 1 on *h* 2	156	30
e on h 1 return . . .	94	15

mineral has been found in small, extremely fragile, tabped crystals, in the ejected stones of Vesuvius, at Capo near Rome; in fibrous masses, with apophyllite, at a and Dognatska in the Bannat of Temeswar; in cintone from Ceylon; and in fibrous radiated masses in the castle rock of Edinburgh. The massive varieties lly composed of small columnar crystals lying in all is, or fibrous — the fibres parallel or diverging. It acies garnet, fluor, and native silver, at Pargas, Finland. United States it forms a large vein in gneiss at Wills, N. Y.; is both granular and massive, associated with also in Bucks county, Penn., in large masses with e, pyroxene and sphene. At Greenville, Lower Canada, eautiful greenish-white variety of this species, mixed een coccolite, occurs abundantly in limestone. It frebears considerable resemblance to some varieties of e. By fusing lime and silica in the required proporeavable masses resembling this mineral have been ob-

MELLILITE, H. Bt.*

Its analyses afforded of silica 38·0, lime 19·6, magnesia 19·4, alumina 2·9, oxide of iron 12·1, oxide of manganese 2·0, oxide of titanium 4·0. — *Carpi.* Dr. Thomson regards the titanic acid as accidental, and gives the following as the most probable constitution of the mineral: $3MgS+2CalS+\underline{F}S^2$.

Sp. Gr. 3·24 — 3·28. Gives sparks with steel.



P on M or M' . . .	90° 00'
M on M'	90 00
M or M' on *d*	135 00

This mineral occurs in the form of its primary, a right square prism, whose lateral edges are mostly replaced. Internally the crystals are of a honey-yellow or orange color; externally they are usually coated by oxide of iron of a brown hue. B B, it melts without effervescence into a greenish glass; and, when reduced to powder, gelatinizes with nitric acid.

It has only been found at Tivoli and Capi di Bove, near Rome, in the fissures of a compact black lava, with nepheline, pleonaste, and other volcanic minerals.

WOLLASTONITE. *Dr. Thomson.*†

Dr. Thomson has separated the name of Wollastonite from table spar, and applied it to a mineral very nearly resembling it in some of its characters, but which has a different composition, being composed, according to his analysis, of

Silica	52·744
Lime	31·684
Soda	9·600
Magnesia	1·520
Alumina	0·672
Water	2·000
	99·200

By throwing out the iron and alumina as accidentally present, and uniting the magnesia with the lime, it is evident that the mineral is composed, as stated by Dr. Thomson, of 4 atoms bisilicate of lime, and 1 atom tersilicate of soda. Formula: $4CalS^2+NS^3$. It thus seems to belong to the alkalino-earthy class of the present arrangement; but as the name of Wollas-

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* Mellilite, from its being of a honey-yellow.

† Outlines of Mineralogy, &c , vol. i. p. 130. This mineral differs from the zeolites in containing lime in the place of other bases, and seems more nearly allied in its composition to the stellite of Dr. Thomson. (Am. Ed.)

ı honor of one to whom mineralogy is under very great
ons, has now become fixed in its application to table
bisilicate of lime, the editor will merely introduce Dr.
n's description (that mineralogists may compare other
ns with it), and allow the mineral to remain in its pres-
ection until its crystallographical characters have been
ned, and it is decided whether its present name is to
ned, or another applied to it. Its color is white, with
shade of green; texture is fibrous, the fibres in tufts,
g from a centre, showing it to be imperfectly crystal-
ustre inclining to silky; translucent on the edges;
splintery; fragments sharp-edged; hardness 2·5; spe-
vity variable from 2·85 to 2·876. B B, it fuses with
fficulty, and without frothing, into a white enamel.
rax it fuses into a bead, which is yellow while hot, but
colorless when cold. With biphosphate of soda, in
able excess, it melts into a colorless bead, leaving a
keleton. With carbonate of soda it froths and forms
e bead, having a shade of reddish-blue.

urs in considerable quantities in veins in a greenstone
uated near Kilsyth, and not far from the banks of the
nd Clyde Canal, Scotland; also in the neighborhood
burgh, where it was discovered by Lord Greenock.

TERSILICATE OF LIME.*

easily frangible; its behaviour, B B, is similar to that of table spar; on the edges it fuses with difficulty into a semi-transparent glass; with borax it fuses easily, and forms an amethyst-colored glass.

It occurs in transition limestone at Gjellebak, not far from Christiania in Norway. It had been mistaken for tremolite until Hisinger pointed out its true nature.

GISMONDINE.

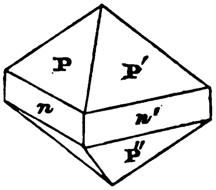
Abrazite, *Brocchi.* Zeagonite, *Gismondi.* Gismondine, L. Abrazite Kouphone Spar, *Shepard.* Spatum Volcanicum, D.

Silica	57·45	41·4
Alumina	7·36	2·5
Lime	25·30	48·6
Magnesia	2·56	1·5
Oxide of iron	3·00	2·5
Oxide of manganese	0·50	0·0
	96·17 Viviani.	96·5 Carpi.

From the last analysis Dr. Thomson observes that it may prove a sesquisilicate of lime, admitting the alumina, magnesia, and iron as accidental; but a more accurate analysis is necessary, in order to establish its chemical constitution in a satisfactory manner.

Sp. Gr. 2·16 — 2·2. H. = 7·0 — 7·5.

Primary form, a right square prism; secondary, the same, surmounted by four-sided pyramids.



P on P′ . . . . . . 122° 58′

P′ on P″ 85 40

Occurs in white translucent crystals, having an adamantine lustre, and presenting an imperfect cleavage parallel to *n*. Fracture conchoidal. B B, it phosphoresces, and becomes friable, but does not melt. It gelatinizes in acids without effervescence.

This species occurs at Capo di Bove, near Rome, coating the cavities of ancient lava, along with other volcanic minerals.

AUGITE. PYROXENE.[*]

Augit, W. Pyroxéne, H. Paratomous Augite Spar, M. Augitus Diatomus, D.

Combination of silica, lime, protoxide of iron, and sometimes manganese and alumina.

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[*] Augite, from the Greek, splendor, in allusion to the brilliancy of its crystals; Pyroxéne, signifying a guest in the domain of fire — unaltered by heat.

Analyses of black and green varieties.

	Black.	*Green.*	*Green.*
	Taberg.	New York.	Dalecarlia.
Silica	53·36	52·66	54·08
Lime	22·19	23·33	23·47
Protoxide of iron	17·38	12·30	10·02
Magnesia	4·99	5·73	11·49
Alumina	0·00	6·66	00·00
Oxide of manganese	0·09	0·00	0·61
	98·01 Rose.	100·68 Seybert.	99·67 Rose.

	Green.	*Black.*	
	Dalecarlia.	Piko, Azores.*	Finland.†
Silica	54·55	50·40	50·99
Lime	20·21	21·10	20·00
Protoxide of iron	8·14	22·00	21·00
Magnesia	15·25	2·40	4·50
Alumina	0·14	2·90	0·00
Oxide of manganese	0·73	00·30	3·00
	99·02 Rose.	99·18 Hochstetter.	98·50 Berzelius.

Analyses of white augite.

	Finland.	Wermeland.	Finland.‡
Silica	54·64	55·32	54·83
Lime	24·94	23·01	24·76
Magnesia	18·00	16·99	18·55
Protoxide of manganese	2·00	1·59	0·00
Peroxide of iron	1·08	2·16	0·99
Alumina	0·00	0·00	0·28
	100·66 Rose.	99·07 Rose.	99·73 Bonsdorf.

These analyses, divided by the atomic weights, will show the mineral to consist of bisilicates of lime, magnesia, and iron. Formula: $CalS^2+(Mg+\underline{F})S^2$.

Dr. Thomson has separated common white augite from the dark varieties, and described it as a distinct species, under which are included one or two of the varieties described in the present connection. Regarding the oxides of iron and manganese as accidental, they give a formula ($CalS^2+MgS^2$) which slightly differs from that of the pyroxenes; but as all the other characters are common to both, it does not seem absolutely necessary that we should maintain the distinction. In all the analyses given, both of white augite and the dark varieties, there is a very close agreement in atomic constitution, the atoms of silica being almost exactly double those of the bases, showing the mineral to consist of bisilicates. But the atoms of the bases vary among each other, owing to their well-known isomorphic nature, one replacing another without any alteration in the crystalline form of the mineral: whence the numerous varieties depending principally on color and the variable proportions of iron and manganese. Beudant (*Traité*, t. ii., p. 225) regards the mineral as a simple bisilicate of lime and iron, and makes hedenbergite (variety sixth), — in which the magnesia is nearly replaced by protoxide of iron, and the iron and lime are present in nearly equal atoms — the true type of the species. Calculating from the last two analyses here given, of the dark colored varieties, we shall have almost precisely the same result.*

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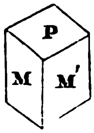
* Part of a macled crystal, analyzed by Carl Hochstetter. Lond., Edin., and Dub. Phil. Jour. and Mag., 1843. Vol. xxii., p. 370.

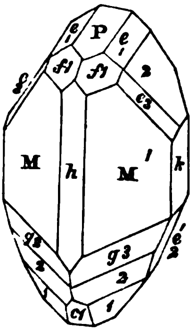
† Dark reddish-brown malacolite, from Degerö, Finland.

‡ The specimens from Finland were from different localities; one from Orrijervi, the other from Tammare. They belonged to the variety called malacolite.

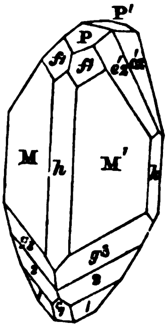
Augite occurs crystallized, also in grains, and amorphous; the crystals generally small, and often hemitrope or macled. Its color is white, green, brown, or brownish-black, sometimes black; with vitreous or resinous lustre, and opake; fracture conchoidal, uneven. It cleaves parallel to the sides of an oblique rhombic prism of 87° 5′, and 92° 55′, as determined by the reflecting goniometer, which therefore is its primary form. B B, it fuses, emits a few bubbles, and finally yields a glassy globule, more or less tinged by iron; it is readily soluble with borax. Several varieties of augite have been obtained artificially by means of fusion; and they are frequently met with among the iron slags of Sweden. All varieties of this mineral seem to owe their peculiarities to the isomorphous nature of iron and some of the other substances that enter into its composition, and replace each other, without producing any change in the crystalline form of the species; and probably to no one variety is this remark more applicable than to Jeffersonite, the variety next to be described.

Primary form.





Macle.



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* The formula given on the opposite page applies only to the dark colored varieties of his mineral, and should have preceded the analyses of white augite, of which another ormula is given.

M on M′	87° 5′	P on *f* 1	146° 15′
M or M′ on P . .	100 10	*e* 1 on *é* 1	120 38
—— —— *h*. . .	133 33	*e* 1 on *k*	138 48
—— —— *f* 1 . .	134 40	*e* 2 on *e* 3	164 00
—— —— *g* 1 . .	122 15	*f* 1 on *f* 1	131 30
—— —— *g* 2 . .	144 25	*g* 1 on *g* 1	120 38
—— —— *g* 3 . .	155 33	*g* 1 on *c* 1	150 18
—— —— *e* 2 . .	132 00	*g* 3 on *g* 3	87 10
M′ on *k*	136 15	*h* op *c* 1	105 20
P on *h*	106 15	P on P′ macle	148 30
——— *e* 1	150 2	*é* 2 on *é* 2	159 50
——— *e* 2	131 30		

Augite is a common volcanic production; but that it existed prior to its matrix being subjected to volcanic action, there is no doubt. The debris of the Monte Rossi on Etna is full of detached crystals of black augite; and in the volcanic regions of Vesuvius, Stromboli, Auvergne, Teneriffe, and Bourbon, they are also of frequent occurrence. Augite is likewise met with, imbedded in basalt, at Aussig and Toplitz in Bohemia; in Hungary, Transylvania, Hessia, and elsewhere on the continent; occasionally also in primitive rocks, as in Greenland, and in the iron mines of Arendal in Norway. The crystals met with in basalt are generally larger than those found in lava.

Remarkably beautiful crystals of augite have been found at Bytown, Upper Canada, specimens of which have been very generally distributed by Professor Holmes of Montreal, to whom we are much indebted for our knowledge of the mineralogy of the Canadas. The crystals (sometimes an inch in diameter and two inches long) are disseminated through calcareous spar; they present white striated faces, and are often semi-transparent. Crystals of the black variety occur abundantly in the trap of Montreal Mountain, and those of a green color at Grenville, Lower Canada, and Perth, Upper Canada: at the latter place finely crystallized in a reddish calc spar.

The following are varieties of the preceding species:

1. JEFFERSONITE,* or Polystomous Augite Spar, *Keating*. Foliated Pyroxene of *Troost*. Var. Pyroxene.—*Dana and Shepard.*

This mineral was discovered by Messrs. Keating and Vanuxen in 1821, and has been described by these gentlemen at length in vol. ii. of the *Jour. Acad. Nat. Sci. Philad.* From its chemical composition and other characters, they came to the conclusion that it was a new species. In vol. iii. of the same journal, Dr. Troost† has instituted a careful comparison between this mineral and pyroxene, as to its crystalline forms, and shown that its primary crystal, as well as many of its secondary modifications, correspond precisely with those of the latter: and it is now usually classed as a variety of pyroxene in the systems. The editor has not therefore retained it in the present edition of this work as a distinct species. The following is the analysis of Prof. Keating:

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* In honor of the late Thomas Jefferson, President of the United States.

† Journal of the Academy of Natural Sciences, Philadelphia; vol. iii, p. 105.

Silex	56·0
Lime	15·1
Protoxide of manganese	13·5
Peroxide of iron	10·0
Oxide of zinc	1·0
Alumina	2·0
Loss by calcination	1·0
	98·6

The formula given by Keating, and which we obtain by dividing the products by the atomic weights — leaving out the zinc and alumina — is $4CalS^3+3\underline{M}nS^3+2\underset{\cdot}{F}S^3$.* It will be observed that protoxide of iron is replaced by protoxide of manganese.

Sp. Gr. 3·5. H. = 4·5.

It is found in large foliated masses, sometimes a foot in length, and in groups of large and well-defined crystals, from two to six inches in diameter; usually of a dark olive-green color, passing into brown; translucent on the edges, and yielding to mechanical cleavage in three directions, parallel with all the planes of an oblique rhombic prism, the angles of which correspond with the measurements given by Haüy of Pyroxene, which also presents the same secondary forms. The cleavage is easily obtained parallel to the base and two sides of the prism, but the third cleavage is obtained with difficulty. On the planes of cleavage the lustre is semi-metallic; on the cross fracture resinous. B B, it fuses readily into a black globule, but does not act upon the magnet. In heated muriatic acid a portion is dissolved. It occurs with franklinite, garnet, &c., at Franklin, Sussex County, N. J.

2. Diopside.† Diopsid, W. Var de Pyroxène, H. Mussite, Alalite. Union of silica, lime, magnesia, and a little protoxide of iron. The Piedmontese variety contains silica 57·5, lime, 16·5, magnesia 18·5, oxides of iron and manganese 6·0 — *Laugier.*

Sp. Gr. 3·31. Scarcely scratches glass.

Diopside occurs in prismatic crystals, which are colorless, or green of various shades; and translucent or transparent. Their primary is an oblique rhombic prism, of the same form and measurement as that of augite. The crystals are generally striated longitudinally, have a shining lustre, and may be cleaved parallel with the planes of the primary prism. B B, it fuses alone into a colorless semi-transparent mass; with borax into a diaphanous glass.

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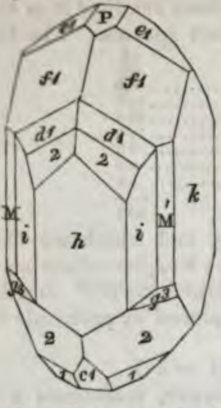
* Jour. Acad. Nat. Sci., Philad., ii., p. 99.

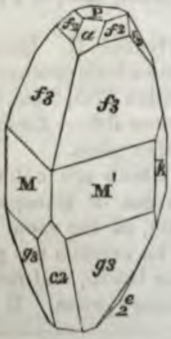
† From the Greek, signifying transparency, in allusion to the occasional transparency of its crystals.



M on M′	87°	5′
M or M′ on P	100	25
—— —— *h*	133	35
—— —— *f* 1	134	45
—— —— *g* 1	122	10
—— —— *g* 2	144	12
—— —— *g* 3	155	35
—— —— *i*	152	35
M′ on *k*	136	17
P on *h*	106	30
*f*1 on *f*1	131	30
*g*2 on *g*2	95	25
*g*3 on *g*3	87	18
h on *i*	162	30
*d*1 on *h*	165	00 *c. g.*
*d*2 ——	175	00 "
*d*2 on *d*2	170	00 "

It was first discovered by Bonvoisin, in veins traversing serpentine, at Ala in Piedmont (hence Alalite), where it occurs in translucent crystals, accompanied by epidote, hyacinth, red garnet, and crystallized green talc; and latterly has been obtained in large individuals and crystalline masses, sometimes of a fine pistachio-green color, at the Rothenkopf in the Zillerthal, Tyrol. In the United States fine crystals of this variety have been found in the limestone quarries of Bolton, Mass.

3. Pyrgom. Fassaite.* Is generally of a dingy-green color; assumes nearly the same crystalline form, and readily yields to mechanical division parallel to the lateral planes of a prism of the same measurements as that of augite.



M on M′	87°	5′
M or M′ or P′	100	12
—— ——*f* 2	146	30
—— ——*f* 3	169	5
—— ——*c* 2	125	30
—— ——g 3	155	20
M′ on *k*	136	10
f 2 on *f* 2	120	20
f 3 on *f* 3	95	38
g 3 on *g* 3	87	5
P on *a*	148	23
——*f* 2	137	50
——*f* 3	114	40
f 2 on *a*	150	1
g 3 on *c* 2	133	32

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* Fassaite, from its locality the valley of Fassa.

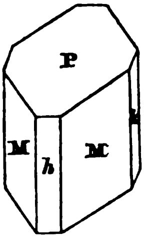
It is found in the valley of Fassa in the Tyrol.

4. Sahlite. Sahlit, W. Pyroxène laminaire gris-verdatre, H. Malacolithe, Bt. Baikalite.

		Finland.	Siberia.
Silica	50·0	54·63	44·0
Lime	20·0	24·76	20·0
Magnesia	19·0	18·55	30·0
Oxide of iron and manganese	4·0	0·99	6·0
Alumina	3·0	0·28	0·0
	96·0 Vauquelin.	100·41 Bonsdorf.	100·0 Lowitz.

Sp. Gr. 3·256.

Sahlite occurs in prismatic crystals of four or eight sides, and generally with inclined summits; it is greenish-grey, feebly translucent, and scarcely hard enough to scratch glass. It also occurs massive. The structure is lamellar, with joints parallel to the planes of an oblique rhombic prism, of the same measurements by the reflecting goniometer as that of augite; the primary form of the two substances is therefore the same, but sahlite readily allows of mechanical division parallel to the oblique terminal planes of the prism, which augite rarely does. B B, it melts *per se*, with slight effervescence, into a translucent glass; and is soluble in borax, salt of phosphorus, and soda, forming with them a clear glass.



M on M	87°	5′
——— on P	100	40
——— on *h*	133	34
M on *k*	136	35
P on *h*	106	12
—— *k*	90	00
h on *k*	90	00

Sahlite occurs principally in the silver mines of Sahla* in Sweden, and at Arendal in Norway; the variety termed *Baikalite* is found in granite at the mouth of the Sljumanka River, which falls into Lake Baikal in Siberia.

This variety has many localities in the United States: as at West Haven, Ct., Monroe, N. Y., and Bolton, Mass.

5. Coccolite. Kokkolith, W. Pyroxène granuliforme, H. Consists of 50 silica, 1·5 alumina, 24 lime, 10 magnesia, 7 oxide of iron, and 3 oxide of manganese. — *Vauquelin.*

A specimen of American coccolite, analyzed by Seybert, gave as follows:

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* Whence Sahlite.

	Ticonderoga.
Silex	51·00
Lime	23·00
Magnesia	6·26
Alumina	3·00
Protoxide of iron	14·43
Water	0·66
	98·55 Seybert.

It presents various shades of green and bluish green, and occurs in small translucent masses or grains* of irregular shapes, which are very slightly coherent, but sufficiently hard to scratch glass; structure lamellar and lustre vitreous. It occurs principally in the iron mines of Arendal in Norway. In the United States, of a fine green color, with garnet and tabular spar, at Williamsborough, N. Y. Also in large masses at Boonville, N. Y., and abundantly at Rogers Rock, Lake George, imbedded in felspar, and associated with sphene and plumbago.

6. **Hedenbergite** is a variety from Tunaberg in Sweden, the analysis of which, by Rose, gave silica 49.01, lime 20·87, protoxide of iron 26·08, magnesia and protoxide of manganese 2·98. It is named in honor of the chemist Hedenberg, and Beudant makes it the name of a distinct species, under which he includes several varieties. It is a lime-iron augite, and agrees in composition with the specimen from one of the Azores, the analysis of which is given on p. 72; and also with that analyzed by Berzelius, next recorded on the same page.

7. **Rensselaerite.**† This name has been given by Prof. Emmons to a variety of pyroxène found in the northern part of New York. Hardness 3·5 to 4; specific gravity 2·874. The crystalline form under which it appears is an oblique rhombic prism of the same measurement as pyroxène. Cleavage, or natural joints, parallel to the terminal planes. The weathered surface is softer than the interior, and is easily cut with a knife. Color usually grey, with shades of red, green, yellow, but sometimes nearly black. Structure compact, slightly crystalline, though the individuals are not perfectly developed. Distinct crystals of a reddish hue occur singly in granular carbonate of lime. Fracture uneven; individuals strongly coherent; B B, whitens and fuses with difficulty into a white enamel. It occurs in primitive limestone, in extensive masses, at Hermon, Gouverneur, and Canton. By some the mineral has been referred to steatite and soapstone. It seems to have the character of a rock as well as a simple mineral. It has not been analyzed.

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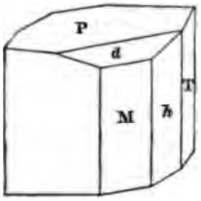
* Whence Coccolite, from the Greek, signifying a granular stone.

† In honor of the late Stephen Van Rensselaer. See Natural History of New York, Part iv., p. 74; by Prof. Emmons.

BABINGTONITE.*

Axotomous Augite Spar, M. Babingtonite, *Levy*. Augitus Acrotomus, D.

Sp. Gr. 3·5. H. 5·5 — 6·0.



P on T	88°	00	Levy.
P on M	92	34′	
M on *h*	137	5	
M on *g*	132	15	
M on T	112	30	
T on *h*	155	25	
P on *d*	150	25	
h on *g*	89	20	

Sometimes the faces marked M are wanting. Color dark-greenish-black; the splinters faintly translucent, and appearing green perpendicular to P, brown parallel to it. Lustre vitreous. Surface brilliant. Cleavage perfect parallel to P, less so to *T*. Fracture imperfect conchoidal. Primary form as given by Brook, a doubly oblique prism.

B B it fuses on the surface into a black enamel, and with borax gives a transparent amethystine colored globule, which in the reducing flame becomes bluish-green.

Babingtonite resembles certain dark-colored varieties of augite, from which it was first distinguished by Levy. Acording to Children, it is composed of silica, iron, manganese, and lime, with a trace of titanium; but it would seem that no one has had a sufficient quantity of the mineral for a thorough analysis. It occurs in very distinct crystals at Arendal in Norway, associated with epidote and massive garnet; and in the Shetland Isles imbedded in white quartz.

The only locality of this species in the United States, is at Charlestown, Mass., in the sienite containing prehnite, chabasie, &c., where it was first observed by Prof. Nuttall.

CLINTONITE.†

Seybertite of *Clemson*. Holmesite of *Dr. Thomson*. Bronzite, *Shepard*. Seybertite, *Dana*. *Mohs*.

This mineral has been analyzed both by Mr. Clemson and Dr. Thomson, but with results so different that we shall not record its atomic constitution, until we have the analysis of a more purely crystallized specimen. It is possible, however, that the specimen sent to Dr. Thomson, was not so pure as the one taken immediately from the locality, and placed in Mr. Clemson's hands expressly for analysis.

---

[*] Named in honor of Dr. Babington. Ann. Phil., 2nd series, vii. 275.

[†] In honor of the late Governor De Witt Clinton. Named by Messrs. Horton, Finch and Mather, by whom it was discovered.

Silica	17·00	19·35
Alumina	37.60	44·75
Magnesia	24·30	9·05
Lime	10·70	11·45
Protoxide of Iron	5·00	00·00
Water	3·60	4·55
Per Oxide of Iron	0·00	4·80
Zirconia	0·00	2·05
Oxide of Manganese	0·00	1 35
Fluoric Acid	0·00	0·90
	98·20 Clemson.[*]	98·25 Thomson.[†]

Sp. gr. 3.07 to 3·10. H = 4·0 to 4.5

Color copper-red, reddish brown, yellowish brown, and reddish white. Streak yellowish grey. Occurs in masses which are imperfectly crystallized, or present a foliated structure. Primary form an oblique rhombic prism, M or M′ about 94°. Cleavage, according to Breithaupt, parallel with planes tangent to the angles of the base, perfect; and very imperfect, parallel with the primary planes. Lustre metallic pearly, opake to translucent; its thin laminæ sometimes transparent. Alone B B infusible, but with carbonate of soda and borax it melts into a transparent white pearl. Reduced to an impalpable powder, Clemson observed, that it was attacked by acetic, nitric, muriatic and sulphuric acids.

It bears some resemblance to bronzite as well as to some varieties of mica, but from the former it differs entirely in chemical composition, and it is distinguished from the latter by its difficult separation into laminæ, and by its want of flexibility. Its hardness also exceeds that of mica. Its only locality is Orange county, N. Y., near the village of Amity, where it occurs both in serpentine and white limestone. It is associated with spinelle, and several other crystalline minerals. Dr. Horton remarks that it sometimes so completely and uniformly invests the larger spinells as to lead at first sight to the impression that they are real octahedrons of Clintonite. Crystals have been observed by him modified both on the terminal and lateral edges of the primary, but their exact relations to these planes have not been ascertained.[‡]

BUCKLANDITE.[§]

Dystomic Augite Spar, *Haid.* Bucklandite, *Levy.* Augitus Dystomus, D.

Sp. Gr. 3·94. Harder than augite.

Primary form an oblique rhombic prism of 109° 20′ and 70° 40′.

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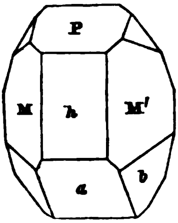
[*] Am. Jour. of Sci., vol. xxiv., p. 171.

[†] Ibid., vol. xxxi., p. 173.

[‡] See Mineralogy of New York, by Prof. Beck, p. 362, where two figures are represented. It seems somewhat doubtful which of the names applied to this mineral, is ultimately to prevail. I concur in the opinion of Prof. Beck, that the name originally given to it by its discoverers should claim the preference, and have inserted it as Clintonite. [Am. Ed.]

[§] In compliment to Professor Buckland of Oxford.



P on M	103° 56′	Levy.
M on M	70 40	
M on *h*	125 20	
P on *h*	114 55	
P on *a*	99 41	

Color dark brown, nearly black, or velvet black. Opake. Lustre vitreous. Cleavage not observable. Fracture uneven. According to Rose, it is completely soluble in muriatic acid.

This very rare mineral bears much general resemblance to augite. It was distinguished and described by Levy, to whom we are indebted for the above measurements. It occurs at Arendal in Norway, with black hornblende, felspar, and apatite; and in minute brilliant crystals in lava, at the lake of Laach on the Rhine, (*Allan's Manual.*) Also imbedded in the granite of Werchoturgi in the Urals.

AMPHIBOLE.* HORNBLENDE.

Hornblende, W. Var. de Amphibole, H. Hemi-prismatic Augite Spar, M. Augitus Protæus, D.

This mineral occurs crystallized, massive, and slaty. It is composed essentially of silica (partly replaced by alumina,) magnesia, and lime.

	Black, Pargas.	*Deep Green*, Aker.
Silica	45·69	47·21
Lime	13·85	12·73
Magnesia	18·79	21·86
Protox. of Iron	7·32	2·28
Protox. of Manganese	0·22	0·57
Alumina	12·18	13.94
Fluoric Acid	1·50	0·90
	99·53 Bonsdorff.	99·49 Bonsdorff.

Dr. Thomson is disposed to regard white tremolite (amphibole blanc of Haüy) as exhibiting this species in its purest form; and from the mean of several accurate analyses by Bonsdorf, rejecting a small portion of alumine, iron and manganese as accidental, he obtains this formula, $CalS^3+3MgS^2$, which is the same as that given by Beudant.† Adopting this formula, we have only to suppose the dark colored varieties, as the two above-mentioned, to be composed of white tremolite mixed with variable proportions of foreign matter.

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* Named by Haüy from αμφιβαλος, ambiguous, because it was confounded with *tourmaline*. Under the term amphibole Haüy included several minerals which Werner had described as distinct species, but which possess the same crystalline form, differing like the garnets in the proportions of their chemical constituents, as well as in color, hardness, and specific gravity. They are thus treated of in this work. [AM. ED.]

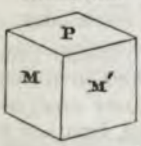
† See the two first analyses by Bonsdorff under tremolite, p. 84, of this work.

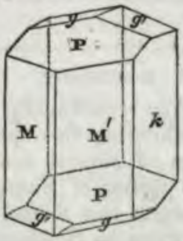
Sp. Gr. 3·0 to 3·1. H = 50 — 6·0.

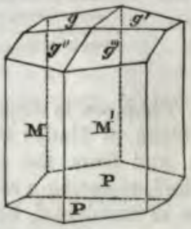
Crystallized Hornblende is found in prismatic crystals, occasionally isolated, but more often confusedly aggregated, and frequently macled. The crystals cleave readily and with brilliant surfaces parallel to the sides of a rhombic prism of 124° 30′ and 55° 30′ by the reflecting goniometer, but not parallel to the terminal planes, which are assumed to be oblique to the axis of the prism; and hence the primary crystal is an oblique rhombic prism, the declination of the terminal planes being from one obtuse angle of the prism to the other. Color dark bottle-green or brownish-green, or brown approaching to black, but, when pulverized, of a greenish-grey: lustre vitreous; yields pretty easily to the knife; opake, or presenting on the thinnest edges a fine red color by transmitted light; when massive, tough, and difficultly frangible. The black varieties invariably contain more iron than those of a lighter color, as may be ascertained by bringing them in contact with the magnetic needle; some of them have been found to contain about nineteen per cent. Dark-green lamellar hornblende fuses alone B B, with effervescence and intumescence, into a black brilliant glass. It affords with borax a transparent globule, and with salt of phosphorus a glass which becomes opaline on cooling.

The appellation of *Basaltic* has been given particularly to those cleavable and highly crystalline black hornblendes which occur in basaltic and amygdaloidal rocks. That of *Carinthin* applies to one of a green color from the Sau Alpe in Carinthia.

Primary form.







M on M′	124° 30′	P on *k*	90° 00′
M or M′ on P . .	103 01	*g*′ on *k*′.	106 00
M′ on *k*	117 32	*g*′ on *g*″ or *g*′ on *g*‴	148 42
P on *g* or *g*′ . . .	145 43		
M on *g* or *g*′ . . .	68 42		
g on *g*′	148 22		

The 3d fig. represents a *hemitrope*, in which one half of the crystal is turned round, and is thus attached to the other half.

Massive Hornblende has a crystalline structure, consisting of minute and often of long crystals intersecting each other, sometimes confusedly radiating. Superficially it frequently assumes a ferruginous brown from decomposition; is very tough, and difficult to break.

Hornblende-slate, Hornblende Schiefer, W. Is commonly of a greenish-black color; and, except that it has a slaty or schistose structure, agrees in all its characters with the massive.

Hornblende is a very abundant mineral, being an essential ingredient of syenite and greenstone; and occurring frequently in granite, gneiss, basalt, and lava. It is therefore found in almost every country, but more particularly in the repositories of magnetic iron at Arendal, and other mining districts of Norway and Sweden; in large, frequently hemitrope crystals, in amygdaloid, near Teising and Toplitz, in Bohemia; in crystals occupying the drusy cavities of Vesuvian minerals; and in Greenland of a peculiar asparagus-green color. Massive hornblende is met with on the Sau Alpe in Carinthia, and in several parts of Saxony; while hornblende-slate forms beds in gneiss, mica-schiste, and other primitive rocks.

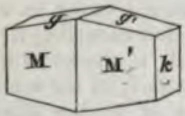
This mineral has numerous localities in the United States, a few only of the most important of which will be given. At Edenville, N. Y., highly brilliant crystals of a hair-brown color, occur in limestone; also at Amity, reddish-brown crystals ten inches in diameter; and at Gouverneur, same state, beautifully perfect crystals of a dark green color, three inches in diameter, associated with crystallized felspar and phosphate of lime. At Franconia, N. H., the crystals in long slender prisms penetrating chlorite and magnetic iron ore, are of a brilliant black color, and truncated on their acute lateral edges. At Chester, Mass., with their obtuse edges truncated.

The following are the varieties of the present species:

1. **Pargasite.** Composed, according to the analysis of two able chemists, of

Silica	46·26	51·75
Magnesia	19·03	18 97
Lime	13·96	10·04
Alumina	11·48	10·93
Protoxide of iron	3·48	3·97
Protoxide of manganese	0·36	—
Fluoric acid	1·60	1·83
Water	0·61	
	97.21 Bonsdorf.	97·49 Gmelin.

It occurs disseminated in somewhat round semi-crystalline masses, and in six-sided crystals with diedral summits. It yields to cleavage parallel to the lateral plane of a rhombic prism of the same measurements as the oblique rhombic prism of hornblende; but not parallel to the terminal planes. Color, however, is the principal difference between hornblende and pargasite, the latter being somewhat translucent, and of a lighter green, or more generally of a bottle-green hue. It is harder than fluor, but is scratched by quartz. Specific gravity 3·11. Its comportment, B B, is the same as black crystallized hornblende, except that the glass is less colored.



M on M′	124 30′
M′ on *k*	118 10
M on *g* or M′ on *g*′	68 48
g on *k*	105 32
g on *g*	147 54

It is found at Pargas,* near Abo, in Finland, in calcareous spar.

In the United States, at Antwerp, N. Y., and at Bolton Mass., in limestone.

2. Tremolite.† Tremolith, W. Var. de Amphibole, H. Tremolite, Br. Grammatite, Bt. Common Tremolite, J.

Combination of silica, magnesia, and lime.

	White Gulsjo.	*Yellowish* Fahlun.	Aker.	Cziklowa.
Silica	60·31	60·10	47·21	59·50
Magnesia	24·23	24·31	21·86	26·80
Lime	13·66	12·73	12·73	12·30
Alumina	0·26	00·42	13.94	1·40
Protoxide of iron	0·15	1·00	2.28	0·00
Fluoric Acid	0.94	0.83	0.90	0·00
Water	0.10	0.15	0.44	0·00
	99·65 Bonsdorff.	100.01 Bonsdorff.	99·93 Bonsdorff.	100·00 Beud.

Specific gravity, 2·9—3·1.

Its color is white, occasionally grey with a greenish, blueish, yellowish, or reddish tinge. It occurs in masses composed of delicate crystalline fibres, which sometimes radiate; and in flat deeply striated four, six, or eight-sided prisms, terminated, though rarely, by diedral summits. It cleaves with brilliant surfaces parallel to the sides of a rhombic prism of the same measurement as that of horneblende; its crystals often exhibit the appearance of fissures which are oblique to the axis of the prism. Semi-transparent or translucent, and hard enough to scratch glass, but very brittle; it becomes phosphorescent both by heat and friction. B B, it fuses, in a very strong heat, into an almost opake greyish-white mass. With borax forms a transparent colorless globule.

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[*] Whence Pargasite.

[†] Tremolite, from the valley of Tremola, where it was first discovered.

Asbestiform Tremolite, occurs in masses consisting of fasciculated groups of minute diverging, occasionally radiating fibres; its fracture exposes a delicately fibrous texture, with a glistening pearly or silky lustre. It becomes phosphorescent by friction, which is not the case with common asbestus, a mineral it otherwise much resembles. B B, fragments bubble and fuse with great difficulty into a vitreous mass.

Tremolite occurs in dolomite, at St. Gothard in Switzerland; at Sebes in Transylvania; in Corsica in talc; near Nantes in granite abounding in felspar; the fibrous variety occurs snow-white and translucent in a bed of limestone at Gulsjo in Sweden; in Scotland, in primitive limestone in Aberdeenshire and Iona, and in the marble of Glen Tilt. Asbestiform tremolite forms masses of thin capillary crystals in Switzerland, the Tyrol, the Bannat, and other places; some beautiful specimens are met with at St. Gothard in dark-green groups. In the United States this variety is common in all the dolomite and granular limestone of the country, but the dolomite of Connecticut has furnished the most interesting specimens. At Canaan, in that State, they appear in flattened crystals, often above an inch long and three quarters of an inch wide. The limestone quarries of Bolton, Mass., afford it in fibrous masses of a brownish white color. It occurs in immense quantities at Warren, N. H., forming a large bed in mica slate.

3. NORWEGIAN TREMÓLITE. This variety is found on the Isle of Tiotten, near Heligoland, Norway. It agrees in crystalline structure with common tremolite, but it appears from the analysis of Retzius to contain more silica, and to have a large portion of its magnesia replaced by lime.

Calamite.[*] It occurs in rhombic prisms of a light asparagus-green color, translucent, striated longitudinally, and yielding to mechanical division readily, parallel to the sides of a rhombic prism of the same measurements as that of hornblende. This mineral is soft; in form it resembles tremolite.

It occurs imbedded in serpentine with magnetic iron and calcareous spar, at Normark in Sweden.

4. ACTYNOLITE. Strahlstein, W. Var. de Amphibole, H. This mineral is green, of different hues, sometimes almost black, more or less translucent, and by reflected light yellowish or brownish. It may be divided into three varieties,—crystallized, asbestiform, and glassy.

Combination of silica, magnesia, protoxide of iron, and lime.

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[*] Calamite; *calamus* (Lat.), a reed; from the appearance of its crystal.

	Taberg.	Zillerthal.	Zillerthal.	Penn.
Silica	59·75	53·1	53·1	56·33
Lime	14·25	11·4	10·6	10·66
Protox. of iron	3·95	25·6	21·8	4·20
Protox. of manganese	0·31	0·2	00·0	0·00
Magnesia	21·10	7·8	10·4	24·00
Alumina	0 00	1·7	4·1	1·66
Fluoric Acid	0·76	0·0	0·0	1·03
	100·12 Bonsdorf.	99·8 Beudant.	100·0 Beudant.	97·98 Seybert.*

Crystallized Actynolite generally occurs in acicular hexahedral prisms, which are not regularly terminated, but which yield by mechanical division a prism of the same measurements as that of common hornblende. It has a shining lustre, and is translucent or transparent. Occasionally it appears in fine fibres having a silky lustre, and sometimes disposed in a radiating form*. It is hard enough to scratch glass. *Per se* it fuses, after becoming white, into an opake yellowish or brownish colored glass.

Asbestiform Actynolite presents a green, greenish-grey, or brownish-green color; and occurs both massive, and in capillary crystals which are elastic. The crystals are sometimes disposed in wedge-shaped masses, or in radii promiscuously aggregated; they are opake or slightly translucent on the edges. It melts B B into a yellowish-brown opake glass. The *Byssolite* of Saussure appears, from its analysis and principal characters, to be the same mineral.

Glassy Actynolite differs from the preceding in possessing an external lustre, which is vitreous inclining to pearly; and in being translucent and brittle.

Actynolite is chiefly found in primitive rocks; as gneiss, mica-slate, and limestone. It occurs in long six-sided prisms, imbedded in white talc, at Greiner in the Zillerthal, Tyrol; at St. Gothard; near Salsburg; in Norway; and in Piedmont. In Britain, it has been noticed in the copper veins of the Maudlin mine, near Lostwithiel in Cornwall; in Glen Elg, Inverness-shire; in Skye, and elsewhere, in small quantities. In the United States very beautiful and abundant, of a leek green color, and nearly transparent in steatite and talc, at Windham, Vt. Crystals from this locality in the form of four-sided prisms were obtained by Prof. F. Hall, five inches in length —usually replaced. A delicately acicular variety (Byssolite) is occasionally found in the cavities of the magnetic iron ore of Franconia, N. H. A glassy variety has been found at Concord, Delaware county, Penn., the analysis of which by Seybert is given above.

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* Whence Actynolite, from the Greek, in allusion to the sun's rays.

† Cleaveland's Mineralogy, (Second Edition,) p. 779.

5. Of Asbestus there are several varieties, which generally present a fibrous texture, but vary in respect of flexibility. The fibres have not yet been seen in any very determinate form, but Haüy regarded some which fell under his observation as rhombic prisms. Asbestus* is extremely difficult of fusion in the mass.

According to Dr. Thomson, its varieties contain the following proportions: the excess being owing probably to the formation of a double salt of magnesia during the analyses.

	White Amianthus, Sardinia.	*Rockwood,* Tyrol.	*Mountain Leather,* Strontian.	*Mountain Cork,* Piedmont.
Silica	55·91	54·92	57·65	57·75
Magnesia	27·07	26·08	2.06	10·65
Lime	14·63	0·00	10·00	14·05
Alumina	1·82	1·64	9·50	1·95
Protoxide of iron	6·52	12·60	5·80	18·90
Water	0·00	5·28	21·70	0·00
Protoxide of manganese	0·00	0·00	0·00	1·85
	105·95	100·52	106·71	105·35

Amianthus. Amianth, W. Asbeste flexible, H. Amianthus occurs in long and extremely slender fibres, longitudinally cohering with each other, and easily separated; these are more or less flexible and elastic, and of a whitish, greenish, or reddish color. It is somewhat unctuous to the touch; has a shining or silky lustre; and is slightly translucent. In mass it fuses though with difficulty into a white enamel; but when in single fibres it melts at the flame of a candle.

It usually occurs in serpentine; and is found in the Tarentaise in Savoy, in the longest and most beautiful fibres: that of Corsica is so abundant that Dolomieu used it for packing his minerals. It occurs in Dauphiné, and at St. Gothard in veins in mica-slate; in Saltzburg; the Tyrol; St. Keverne, in Cornwall; Portsoy, in Aberdeenshire; and in the Shetland Isles of Unst and Fetlar.

Amianthus was woven by the ancients into a kind of cloth, in which, being incombustible, they wrapped the bodies of their dead, before being placed on the funeral pile, that their ashes might be collected free from admixture.

Common Asbestus. Asbest. dur, H. Common asbestus is much heavier than the preceding variety, its specific gravity being nearly 3·0. It occurs in masses consisting of fibres of a dull greenish color, with occasionally a somewhat pearly lustre; and yields splintery fragments. It is scarcely or not at all flexible, and thereby is distinguishable from amianthus. It is somewhat unctuous to the touch; and is easily fusible B B into a slightly greyish enamel. It is of more frequent occurrence than amianthus; is usually found in veins in serpentine; and is met with in Sweden, Hungary, Dauphiné, the Ural Mountains, &c.; also in serpentine at Portsoy, in Anglesey, and at the Lizard in Cornwall. The various forms of asbestus have numerous localities in the United States, as in the serpentine of Newbury, and Westfield Mass., in the rocks containing anthracite, Worcester, Mass.; in the serpentine of Kellyvale, Vt., in masses which, in color and texture, resemble the finest cotton. At Bare Hill, in Maryland, it also occurs in serpentine.

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* Its name is derived from a Greek word signifying imperishable, or, according to some, unstained, unsoiled.

Mountain Leather. The principal difference between this and the foregoing variety appears to be the position of its fibres. In common asbestus, they are generally even and parallel; in mountain leather, they are interwoven or interlaced. It occurs in flexible flat pieces, having much the aspect of leather; but when very thin has been termed *mountain paper.* It is commonly of a whitish or yellowish white color, and is meagre to the touch. It occurs at Strontian in Argyleshire, and at the Lead Hills in Lanarkshire.

Mountain Cork. Berg Cork, W. Asbeste tressée, H. Rock Cork, J. Mountain cork has a fibrous texture, the fibres being interlaced so intimately as not to be recognizable, or capable of separation. It is opake, has a meagre feel, somewhat resembling that of common cork; about the same hardness; is sectile like that substance; rather elastic, and swims on water. It forms veins in serpentine, and is met with in Norway, Saxony, Spain, &c.; and at Portsoy and the Lead Hills in Scotland.

Mountain Wood. Berg-holz, W. Asbeste Ligniforme, H. Rock Wood, J. Is generally of a brownish color and massive, and has somewhat the aspect of wood, being occasionally so hard and compact as to resemble petrified wood. It breaks into long masses in the direction of the fibres, which are sometimes curved, and separable with ease. It is opake; the fibres rarely elastic. It is fusible into a black slag; and is about twice the weight of water. It occurs at Schneeberg near Sterzing in the Tyrol, with asbestus and other minerals; in Dauphiné; Styria; and at Portsoy in Scotland.

PYRALLOLITE.*

Tersilicate of Magnesia, *Thomson.* Prismatic Tabular Spar, *Shepard.*

This mineral was first described and analyzed by Nordenskiöld, who found it to consist of 56·62 silica, 23·38 magnesia, 5·58 lime, 0·99 peroxide of iron, 0·99 protoxide of manganese, 3·58 water.

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* From the Greek πυϱ, αλλος, λιθος, in allusion to the change of color it presents when exposed to the action of fire.

Sp. Gr. 2·55. H. = 3.5.

Color white, inclining to greenish; lustre dull, sometimes slightly resinous; streak white; opake in the mass, but when reduced to thin laminæ, transparent. If thrown in the state of powder upon a red-hot iron, it gives out a bright-bluish phosphorescence. B B it first becomes blackish, afterwards white, and the edges are reduced to a white enamel; with borax it fuses with facility into a diaphanous glass.

It occurs massive, and crystallized in prisms which are usually an inch in length. It offers distinct cleavages parallel to M and T, of a doubly oblique prism; M on T 94° 36′, P on T 80°. One of the acute and the opposite obtuse terminal edges of the prism B F,* are almost always replaced by single planes, which frequently extend over the whole terminal plane P, forming a bihedral summit to the crystal, and inclining upon T, at an angle of 140° 49′. The opposite terminal edges, C D, are also replaced in the same manner, making an angle with M of about 138° 30′. The face T is considerably larger than the face M. Sometimes only one of the obtuse terminal edges is replaced by a single plane.

Pyrallolite was discovered by Count Steinheil, at Storgood, in the parish of Pargas, Finland, in calcareous spar, with augite, felspar, and scapolite. In the United States, according to Prof. Nuttall, this rare mineral occurs at Kingsbridge, N. Y., in granular limestone, and at Franklin, N. J., in sienite. In the former editions of this work, this substance was comprehended under the species hornblende, with which other systems had arranged it; but it is obviously so distinct from that mineral in some of its characters, particularly in its chemical composition and crystalline form, that the editor has coincided with several others in designating it as a distinct species. It should be observed, however, that Beudant regards it as a variety of talc.

CANAANITE.

Canaanite, *S. L. Dana.* Massive Scapolite, or Scapolite Rock, of *Prof. Hitchcock.*

This substance has been described under several names, as nephrite, saussurite, and pyroxène. Occurring in the massive form, and never crystallized, its character has necessarily been rather ambiguous, though Prof. Hitchcock has compared it with scapolite, and finds that it bears a close resemblance to that mineral in several of its properties,† and has hence very properly characterizes it as above. But it has since been analyzed by S. L. Dana, Esq., by whom its composition has been shown to differ so considerably from common scapolite as to authorize its separation into a distinct species, for which he has proposed * the name derived from the place where it was first discovered. The results of two very careful analyses gave Mr. Dana,

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* See fig. of double oblique prism, p. xi. of the Introduction.

† Final Report on the Geology of Massachusetts, vol. ii., p. 569; and First Report (Second Edition), 1835, p. 315.

Silica	53·366
Protoxide of iron	4·499
Alumina	10·380
Lime	25·804
Magnesia	1·624
Carbonic acid	4·000
Loss	0·327
	100·000

By deducting the equivalent of lime for the carbonic acid, and throwing out the magnesia with the carbonate of lime, which belongs to the dolomite in which the substance occurs, the constitution of this mineral, as atomically expressed by Mr. Dana, is 1 atom bisilicate of lime, 1 atom tersilicate of alumina, and 1 atom silicate of protoxide of iron. Formula: $CalS^2+AlS^3+\underline{F}S$. Its composition thus appears different from that of any other mineral with which we are acquainted. The silicate of iron Mr. Dana is rather disposed to regard as accidental.

Sp. Gr. 3·07. H. about 6·5.

As described by Prof. Hitchcock, its color is white, grey, or bluish-grey. B B, its behavior is exactly like that of crystallized scapolite, melting readily with intumescence into a shining enamel. It sometimes presents aggregations of imperfect prisms, the forms of which are too imperfect to be determined, though the foliated structure is quite obvious; no regular cleavages observed; sometimes exhibits a splintery fracture.

Canaanite occurs very extensively in Canaan, Ct., where, according to the observations of Prof. Hitchcock, it seems to repose between dolomitic limestone and mica slate, forming lofty ridges of mountains. It is often intermixed with the dolomite into which it seems to pass, and it contains both tremolite and augite.

BARSOWITE.†

This mineral bears some near resemblance to the preceding, according to the description we have of it. Both externally and in chemical composition it also resembles scapolite, but is

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[*] In a private communication to the editor, the mineral not having been before described under that name.

[†] Jameson's Edin. Jour. of Sci., vol. xxix., p. 416.

distinguished from it by its structure, and by its relations to the blowpipe and to acids. It is composed of

Silica	49·08
Alumina	32·76
Lime	18·16
	100·00

Calculation from these results shows the mineral to consist of 1 atom bisilicate of lime, 1 atom silicate of alumina; or it differs from Canaanite in containing 3 times its quantity of alumina, without the addition of any iron. It may thus be regarded as a mixture of table spar ($CaIS^2$) and bucholzite (AIS).

Sp. Gr. 2·740. H. = 5·5.

Color snow-white; occurs massive, and in granular distinct concretions. Lustre of the granular varieties feebly pearly; the compact dull. Fracture splintery or imperfectly foliated. Translucent on the edges. B B, it melts (but only on the edges) with difficulty; with borax it melts slowly and calmly into a transparent glass. Pounded and heated with muriatic acid, it is easily decomposed, and forms a thick jelly.

It has been found only in loose blocks, sometimes several cubic feet in size, in the gold sand of Barsowskoj, in the Ural Mountains. Blue crystals of corundum, and white folia of mica, are imbedded in it. It is named Barsowite from its frequent occurrence at Barsowskoj.

ARFWEDSONITE. (*Brooke, Annals of Phil., May,* 1823.

Peritomous Augite-Spar, M. Augitus Peritomus, D.

This mineral has been separated from hornblende (of which it was commonly assumed to be a ferriferous variety), owing chiefly to the measurements which its cleavages afford, and on account of its inferior hardness. It yields to cleavage only parallel to the lateral planes of an (oblique?) rhombic prism, M on M 123° 55′, the measurements of those of hornblende, as usually given, being 124° 30′.* Its color is black without a shade of green; and it is opake and has a resinous lustre. It has not been observed regularly crystallized, but its cleavage planes are very brilliant, much more so than those of hornblende, from which they also serve to distinguish it. B B, according to Children, in the platinum forceps, it fuses readily into a black globule. With borax it affords a glass colored by iron. With salt of phosphorus, a similar but paler globule is obtained; it becomes colorless on cooling, and leaves a skeleton of silica.

According to Dr. Thomson it contains in 100 parts,

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* In stating, in the present edition, that the primary form of this mineral is an oblique rhombic prism, it should be observed that no cleavage has been obtained parallel to the base of the prism, and, therefore, its oblique character is assumed rather than proved. [Am. Ed.]

Silica	50·508
Peroxide of iron	35·144
Sesquioxide of manganese	8·920
Alumina	2·488
Lime	1·560
Water	0·960
	99·580

Omitting the alumina and lime as accidental, it is composed of 4 atoms tersilicate of iron, and 1 atom tersilicate of manganese. Formula: $4FS^3+MnS^3$.

Sp. Gr. 3·4—3·5. H. = 6·0.

This mineral was brought from Kargardluarduk in Greenland, by Sir Charles Giesecké, and was for a time known as *ferruginous hornblende*, until Mr. Brooke examined it, and, from the difference in the measurements of its angles, compared with hornblende, separated it from that species under the name which it now bears, in honor of Professor Arfwedson. It has also been brought from Norway.

According to Professor Shepard, the mineral usually taken for a variety of hornblende, and found in trap porphyry at Plymouth, Vt., agrees with this species.

NEUROLITE.[*] *Dr. Thomson.* (*Outlines of Mineralogy, &c.*, vol. i., p. 354.

This mineral, which Dr. Thomson has analyzed and described as a new species, occurs at Stamstead in Lower Canada, and was sent to him by Prof. Holmes of Montreal. Its analysis gave the following results:

Silica	73·00
Alumina	17·35
Lime	3·25
Magnesia	1·50
Peroxide of iron	0·40
Water	4·30
	99·80

Leaving out the peroxide of iron, and uniting the lime and magnesia, Dr. Thomson thus states its constitution: 5 atoms quartersilicate of alumina, 1 atom quatersilicate of lime and magnesia, and 2½ atoms water. Formula: $5AlS^4+(\frac{2}{3}Cal+\frac{1}{3}Mg)S^4+2\frac{1}{2}Aq$.

Sp. Gr. 2·476. H. = 4·25.

Color greenish-yellow; texture imperfectly foliated, being composed of thin fibres of some breadth; fracture uneven; opake, or only translucent on the edges; brittle; has no appearance of crystallization; B B, it gives out water and becomes snow-white and friable, but does not melt; with carbonate of soda fuses slowly into a transparent glass, slightly yellow, which cracks in various directions on cooling; in borax does not dissolve, but a snow-white opake matter remains in the centre of the colorless globule.

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[*] From νευρον, a tendon, or string. Named from its fibrous texture.

WITHAMITE.*

Augitus Withami, D.

This mineral occurs in minute, translucent, brilliant, carmine-red crystals, which in form bear considerable resemblance to epidote, of which it is considered by Haidinger to be a new and remarkable variety. Lustre vitreous; streak white. The crystals are in spherical radiated groups, which terminate at the circumference in separate individuals, which, by reflected light, have a dark red color, like that of arterial blood. Very fine groups of transparent crystals also penetrate the quartz which occasionally accompanies the mineral.

Its constituents, as determined by Dr. Coverdale, are as follows:

Silica	55·28
Alumina	16·74
Peroxide of iron	21·13
Lime	8·13
Water	3·25
	104·53

The formula deduced from these numbers is thus stated by Dr. Thomson: $3AlS^2+2FS^2+CalS^2+1Aq$.

Sp. Gr. 3·137. H. $=$ 6·0 — 6·5

B B, it intumesces, and fuses with difficulty into a dark greenish-grey scoria. With biphosphate of soda it dissolves with effervescence into a globule, which contains a skeleton of silica; is yellow while hot, but becomes opake on cooling. It behaves very nearly the same as the epidote from Arendal; is not affected by acids either cold or hot.

Minute crystals have been observed, exhibiting the common secondary form of epidote, and indicating a right rhombic prism for the primary; but according to the measurement of Sir David Brewster, M on T is 116° 40′, thus differing considerably from the angle formed by the similar planes on the crystals of epidote, as usually stated in the books.

The following figure shows the form of the crystals described by Sir David Brewster:

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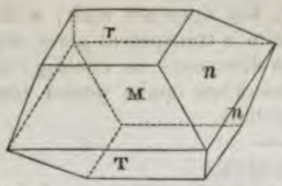
[*] This mineral was described by Dr. Brewster in vol. ii., p. 218, of his Journal; and named by him in honor of its discoverer, Henry Witham, Esq.



M on T	116° 40′
r on T′	128 20

The most interesting optical property of Withamite, observes Dr. Brewster, is its *dichroism*, or *double color*, which it exhibits both in common and polarized light. When common light is transmitted through the two parallel faces of the prism, the tint is of a crimson or amethyst color, with a mixture of straw-yellow. Upon turning the crystal round, the yellow tint disappears, and the color becomes a deep crimson-red. On continuing to turn the prism, the color changes to straw-yellow, and, at the end of half a revolution, the crystal resumes its compound tint. In the groups of crystals which have penetrated the quartz, some of them occupy, accidentally, the position which gives the yellow color, others that which gives the red color, and some that which gives the compound tint; so that, without a knowledge of their dichroitic property, the group might have been considered as composed of three different sets of crystals.

Withamite occurs in a trap rock of a reddish-brown color, at Glenco in Argyleshire, disseminated in grains, or small masses, which shoot out into regular crystals in the larger cavities. Having no other locality, it is a very scarce mineral.

HYPERSTHENE.*

Labradorische Hornblende, W. Var. de Diallage Metalloide, H. Paulite. Hypersthène, Bt. Prismatoidal Schiller Spar, M. Phyllinius Metallinus, D.

Combination of silica, magnesia, and protoxide of iron.

	St. Paul.	Wilmington, Pa.	Isle of Skye.	St. Paul.
Silica	54·25	52·17	51·348	46·112
Magnesia	14·00	11·33	11·092	25·872
Protoxide of iron	24·50	10·73	33·924	12·701
Lime	1.50	20·00	1.836	5·292
Alumina	2·25	4·00	0·000	4.068
Water	1·00	1·00	0·500	0·480
	97·50 Klaproth.	99·23 Seybert.	98·700 Muir.	99·905 Muir.

These several specimens analyzed differ so essentially in their constitution, that we shall not record any formula.

Sp. Gr. 3·3 to 3·4.

Hypersthene is met with either massive, or imbedded in rocks. Its color is dark-brown, or greenish-black; it has a lamellar structure and cleavage parallel with the diagonals and sides of a rhombic prism of about 93° 30′, and 86° 30′ or according to Necker, 93° 12′ and 81° 48′. The cleavage of one side of the prism is more easily obtained than the other; and an indistinct cleavage has been obtained transverse to the axis of the prism, and indicating an oblique termination, on an oblique rhombic prism for the primary. When fractured, it exhibits reflections which are strongly metallic, and sometimes greenish, sometimes of a copper-red color: this lustre is observable in one direction but not in the other; when reduced to very thin laminæ, it is translucent, with a slight tinge of green in one direction, but opake in the other; when pulverized it is dark grey. B B, on charcoal, it fuses easily into a greyish-green opake glass; with borax into a greenish glass.

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* From the Greek, in allusion to its difficult frangibility.

It is found at the island of St. Paul, on the coast of Labrador, chiefly in rolled masses, but also as a constituent of a syenitic or greenstone-rock; along the shores of Newfoundland, and in Greenland. In the United States at Warwick, N. Y., it is found with Brucite, &c., in crystals which are several inches long, and half an inch in diameter; being frequently a modification of the primary, having its acute lateral edges beveled. The most metallic varieties when cut, *en cabochons*, and set as jewels, produce a very pretty effect.

SCHILLER SPAR.[*]

Schillerstein. W. Var. de Diallage Metalloide, H. Schillerspath, Br. Diallage Chatoyante, Bt. Diatomous Schiller Spar, M. Phyllinius Schilleri, D.

This mineral was first noticed by Von Trebna, in 1783, in his mineralogical description of the Hartz, but for the best account of it, and its accurate analysis, we are indebted to Dr. F. Köhler of Cassel.[†] According to this chemist it consists of,

Silica	43·900	41·0	62·00
Magnesia	25·856	29·0	10·00
Alumina	0·000	3·0	00·00
Lime	2·642	1·0	13·00
Protoxide of iron	13·021 [‡]	14·0	13·00
Protoxide of manganese	0·535	00·0	00·00
Water	12·426	10·0	00·00
	99·660 Kohler.	98·0 Drapier.	98·00 Vauquelin.

Dr. Thomson, regarding the iron, &c., as accidental, states the formula of this mineral thus, MgS^2+Aq; or it is a hydrous bisilicate of magnesia. It is evident from the two other analyses, that Vauquelin could not have experimented on real schiller spar. Beudant includes the atoms of iron, &c., in his formula.

Sp. Gr. 2·6—2·8. H. = 3·5—4·0.

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[*] From the German, signifying Chatoyant Spar.

[†] Poggendorf's Annalen, 11, 192.

[‡] Including a small portion of chromium.

It occurs in broad foliated masses, which cleave in two directions parallel to the planes of a rhombic prism of about 93° 30′, and 86° 30′, one of these cleavages highly perfect and easily obtained, the other appearing only in traces. No traces of cleavage planes have been observed, to show whether the prism is right or oblique, but analogy would seem to indicate the latter, which has been assumed. Color olive-green, occasionally pinchbeck brown; with a shining metallic lustre on the faces of cleavage; opake; and yields to the knife. Streak greyish or yellowish-white. Becomes hard when exposed to heat; and B B assumes a metallic aspect, and is attracted by the magnet, but does not completely fuse. Is with difficulty soluble in borax, exhibiting the reäction of iron; and with salt of phosphorus leaves a skeleton of silica. With carbonate of soda it does not fuse, but exhibits on platinum foil the presence of manganese. Reduced to powder, it is readily acted upon by sulphuric or muriatic acid.

It is found in serpentine and greenstone, at Baste in the Hartz. Dana in his Mineralogy, cites two localities in Massachusetts — Blandford, where it is associated with serpentine, and Westfield.

BRONZITE.

Hemi-prismatic Schiller Spar, M. Bronzit, *Karsten.* Var. de Diallage Metalloide, H. Phyllinius Æreus, D.

Combination of silica, magnesia, lime, and the protoxides of iron and manganese.

	Stiria.	Marburg.	Ulten-Thal.
Silica	60·0	57·19	56·81
Magnesia	27·5	32·67	29·67
Lime	00·0	1·29	2·19
Protoxide of iron	10·5	7·46	8·46
Protoxide of manganese	00·0	0·00	0·61
Water	0·5	0·00	0·22
	98·61 Klaproth.	99 61 Kohler.	97·96 Kohler.

Formula, as given by Beudant from the analysis by Klaproth, $4MgS^3+\underline{F}S$.

Sp. Gr. 3·3. H. between 4·0 and 5·0.

Its color is brown, dark-green, or ash-grey. It has a pseudometallic lustre, frequently approaching that of bronze;* structure lamellar. Primary form an oblique rhombic prism. Cleavage very distinct, and readily obtained, parallel to the lateral planes of the prism; and also with P, though often a little curved. M on M 93° 30′. Frequently thin layers of calcareous spar appear between the laminæ; surface striated; opake when in mass; translucent if reduced to thin laminæ. Dana gives the figure of a secondary crystal, showing very deep replacements on the oblique and lateral edges of the primary.

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* Whence its name.

It is found in imbedded crystalline masses in serpentine, near Kraubat in Upper Styria; very abundantly on the Monte Bracco, near Sestri, in Piedmont; imbedded in greenstone at the Baste, in the Hartz; near Hoff, in Bayreuth; at Stempel near Marburg; in the Ulthen-Thal, Tyrol; in the Lizard district of Cornwall; and elsewhere.

CORUNDUM.*

Rhombohedral Corundum, M. Sapphirus Rhombohedra, D.

This species includes sapphire, corundum-stone, and emery. It consists of pure alumina, colored from admixture with oxide of iron.

	Blue Sapphire.		*Red Sapphire.*	*Corundum.*	*Emery.*
	China.			Bengal.	Naxos.
Alumina	98·5	84·0	90·0	89·50	86·0
Lime	0·5	0·0	0·0	0·00	3 0
Silica	0·0	6·5	7·0	5·50	3·0
Oxide of iron	1·0	7·5	1·2	1·25	4·0
	100·0 Klaproth.	98·0 Chenevix.	98·2 Klaproth.	96·25 Tennant.	97·0 Ten.

Sp. Gr. 3·9 — 3·97. H. = 9.

From the analysis of a perfectly white crystal of sapphire, by Dr. Muir, it would appear that this gem is composed of *pure alumina* (aluminum, 53·29; oxygen 46·71); and it is probable that a portion of the silica named in the first analyses, was abraded from the mortar in which the mineral was pulverized.

1. SAPPHIRE.† Saphir, W. Corindon hyalin, H. Perfect Corundum. — *Bournon*. Asteria, of *Pliny*. This consists of two varieties, the sapphire properly so called, and the oriental ruby, whose chief difference consists in their color, although the specific gravity of the latter is also distinctly lower. They assume crystalline forms, which are derived from the same primary crystal, a slightly acute rhomboid, by the reflective goniometer of 86° 4′ and 93° 56′, in which measurements brilliant fragments of the sapphire and corundum-stone perfectly agree. It possesses double refraction. Alone B B it suffers no change whether in fragments or powder; with borax fuses slowly, but perfectly, into a colorless glass. It is not acted upon by acids; but becomes electric when rubbed, a peculiarity which the transparent polished specimens preserve for a considerable time.

The sapphire is only inferior in hardness to the diamond; it occurs crystallized, in six-sided prisms variously terminated; and in rolled masses, which are colorless, or of a blue-red, yellow, or yellowish-green tinge, and transparent or translucent. The crystals yield to cleavage pretty readily in one direction, with a most brilliant surface; but they are extremely difficult to cleave parallel with the other planes of the primary rhomboid. The fracture is conchoidal.

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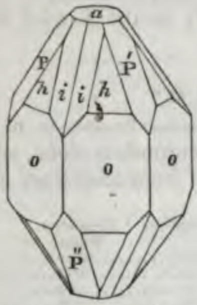
* Corundum is the name given to common corundum by the inhabitants of India.

† Sappheiros, Greek, its ancient name.



P on P'	86°	4'
P or P' on *a* . .	122	27
—— —— *h* . .	154	2
h on *h*	128	20
—— *a*	118	56
—— *o*	151	17
a on *o*	120	00

See Corundum Stone.

Sapphire has obtained several names dependent on its color and lustre: the transparent or translucent, *white sapphire;* the blue, *oriental sapphire;* the red, *oriental ruby;* the yellow, *oriental topaz;* the green, *oriental emerald;* violet, *oriental amethyst;* the greenish blue, *oriental aqua-marine;* with pearly reflections, the *chatoyant* or *opalescent sapphire;* when transparent, and with a pale reddish or bluish reflection, *girasol sapphire.* Some, when cut *en cabochon*, present a silvery star-like opalescence of six rays, in a direction perpendicular to the axis; this variety is termed *Asteria.* The same crystal occasionally exhibits a union of two or three of these different colors.

The *Oriental Ruby*,* which is the most highly prized as an ornamental stone, is of a blood-red, or occasionally a rose-red color; and chiefly occurs in the form of six-sided prisms. If exposed to a great heat, it becomes green, but when cold, returns to its original color. The green sapphire undergoes no change when thus exposed.

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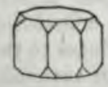

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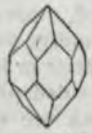

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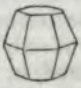

For an illustration of the passage of the primary rhomboid into a six-

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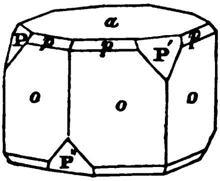
* Ruby, from the Latin *ruber*, red.

sided prism, see page 100. In fig. 1 and 2 the alternate triangular planes are the small remains of the primary rhomboid; the alternate planes of fig. 3 are also those of the rhomboid.



P on P'	86°	4'
P or P' on *a* . . .	122	30
——— ——— *o* . . .	137	30
p on *o*	151	80
——— *a*	118	30
a on *o*	90	00
P on P or *p* on P'	154	7

Blue sapphires are principally brought from Ceylon, either in six-sided prisms variously terminated, or in rolled masses from the beds of torrents; perfect specimens have been found upwards of three inches in diameter. The finest red sapphires are found in the Capelan Mountains, twelve days' journey from Sirian, a city of Pegu; it also occurs near Billin and Meronitz, in Bohemia; in the sand of the brook Expaillie, in France; at Brendola, in the Vicentine; on Mont St. Gothard; and in Portugal.

In the United States a beautiful blue sapphire is met with in the altered limestone of Newton, Sussex county, N. J. The finest specimens are found loose in the soil, usually connected with hornblende or felspar. Small masses externally composed of a dull, greyish-white color, present, when broken, a nucleus of deep blue, which is translucent on the edges. No crystals of large size, and regular form, have been discovered; but it is not unusual to find small individuals presenting a figure very similar to that on page 98. The mineral also occurs in the same limestone at Warwick, N. Y., but inferior in point of color and size. In Connecticut, near Litchfield, pale, bluish crystals have been found associated with kyanite; and in North Carolina single loose crystals exist in the soil.

Prof. Rogers, in his report on Pennsylvania, cites a locality of massive and crystallized sapphire in Newling township, Chester county, where it is accompanied by green tourmaline, beryl, and red oxide of titanium, in beds of limestone. It occurs also in large, detached brownish-yellow crystals, in Delaware county, some of them measuring four inches across the longer diameter of the base.

"Tavernier describes two large oriental rubies, said to have belonged to the king of Visapur, one of which weighed fifty and three quarter carats, and the other seventeen and a half carats. The first was valued at sixty thousand francs, and the latter at seventy-five thousand five hundred and thirty francs.

286143B

The king of Pegu, and the monarchs of Siam, monopolise the fine rubies, as the sovereigns of the peninsula of India have done the diamonds. The finest ruby in the world is in possession of the first; its purity is a proverb, and its worth when compared with gold, is inestimable. The Subah of the Divan is also in possession of one an inch in diameter, and the empress Catherine of Russia, possessed one of the size of a pigeon's egg."

"A blue sapphire is described by the English embassy to Ava, of the weight of nine hundred and fifty-one carats. In the crown jewels of France there is one natural crystal of one hundred and sixty carats, and in the Jardin des Plantes there was one valued at £3,000 sterling."—*Feuchtwanger on Gems.*

Probably the most splendid oriental ruby in the United States, is that now in possession of Col. George Bomford, of Washington city. It was originally purchased at the cost of about $7,000, in Paris, by Mr. Barlow, whilst acting as American minister to the court of France.

2. Corundum-Stone, or Common Corundum, has, probably from its texture, received the name of *imperfect* corundum, and from its hardness, or from its occasional peculiar lustre, that of *Adamantine Spar*. It is sometimes nearly colorless, and somewhat translucent; but more often has a greyish or greenish tint, occasionally reddish; also brown, with a metallic chaytoyant lustre; more rarely blue, yellow and transparent, or black and opake. The common form of its crystal is the six-sided prism, which rarely exhibits a tendency to flat triedal terminations; it occurs also in obtuse and in acute hexahedral pyramids. Is likewise found granular or compact. The form of the primary rhomboid, which perfectly agrees with that of sapphire, is pretty easily obtained by cleavage, because some foreign substance is commonly interposed between the laminæ. B B, this substance comports itself like the sapphire.

Granular corundum has the general appearance of a rough, purplish-colored jasper; but it consists of grains, here and there of a rose-color, closely associated with fibrolite; it is described by Bournon as compact corundum.

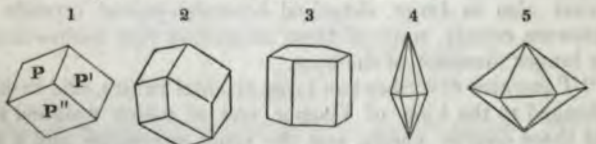
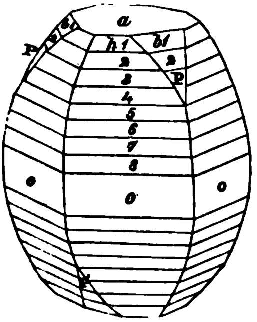


Fig. 1 is the primary rhomboid. Fig. 2 represents a rare variety, in which all the lateral edges of the primary rhomboid are deeply replaced by planes, tending to a six-sided prism, but terminated by portions of the planes of that rhomboid. Fig. 3 is a six-sided prism, arising from the complete replacement of the summits of fig. 2. Fig. 4, a very acute double six-sided pyramid; of these there are several varieties; as well as of obtuse six-sided pyramids, fig. 5. The two latter are rarely found presenting both pyramids.



P on P	86°	4′
P or P on P′ . .	93	56
o on *o*	120	00
a on *o*	90	00
P on *a*	122	50
b 1 on *b* 1	130	00 *c. g.*
b 2 on *b* 2	114	00
h 1 on *h* 1 over *a*	58	00
2 — 2 ———	50	00
3 — 8 ———	40	00
4 — 4 ———	35	00
5 — 5 ———	30	00
6 — 6 ———	24	00
7 — 7 ———	20	00
8 — 8 ———	12	00

The planes *o o o* in conjunction with *a* tend to the production of a regular six-sided prism.

——— *b* 1 and *b* 2 to obtuse rhomboids, by planes situated on those of the primary rhomboid, and inclining on its summit.

——— *h* 1—8 to double six-sided pyramids with triangular planes; they do not however occur as above represented on the same crystal, but on separate crystals, first noticed and measured by Bournon, and since verified by the author's own measurements.

Common corundum occurs in granitic rocks, accompanied by fibrolite, talc, garnet, zircon, and magnetic iron; in China, in the kingdom of Ava, on the coast of Malabar, and in the Carnatic. In smaller quantities also imbedded in magnetic iron at Gellivara in Sweden; near Mozzo in Piedmont in compact felspar; and at St. Gothard, of a red or blue tinge, in dolomite.

In the East Indies it is used for polishing steel, and cutting gems; but the lapidaries of Europe prefer diamond powder, on account of the greater rapidity with which it works.

3. **Emery.** Schmiergel, W. Corindon Granulaire, H. Emeril, Bt. Emery, though it bears little resemblance, is, from its hardness and analysis, considered to be a variety of the preceding. It usually occurs in masses of a blackish or bluish-grey color, having the aspect rather of a fine-grained rock, than of a simple mineral. It occurs both massive and disseminated, with a somewhat glistening lustre, and is extremely tough and difficult to break. Its specific gravity is 3·66. In the Isle of Naxos, emery is found in rounded masses at the foot of primitive mountains. It occurs also near Smyrna, in Italy, and in Spain; but that of Ochsenkopf, near

Schneeberg, in Saxony, seems to be the only variety which has been seen *in situ:* it there occurs with talc-slate, is of a dark blue or black color, and has much resemblance to fine-grained basalt.

DIASPORE.

Euklastic Disthene Spar, *Haidinger.* Diaspore, H. Bt. Epimecius Dissiliens, D. Dihydrate of Alumina of *Dr. Thomson.*

Combination of alumina and water; often mixed with hydrate of iron.

	Ural.		
Alumina	85·14	80·0	76·06
Water	14·56	17·0	14·70
Protoxide of iron	0·00	3·0	7·78
	99·70 Hess.	100·0 Vauquelin.	98·54 Children.

The protoxide of iron being regarded as accidental, the constitution of this mineral is thus represented, taking Children's analysis: Al^2Aq.

Sp. Gr. 3·43. H. = 6· — 6·5

Diaspore is yet a scarce mineral. It occurs massive, in slightly curvilinear laminæ of a shining pearly lustre and greenish-grey color, and which may be readily separated; also in cellular masses, constituted of slender crystals, which have a pearly lustre, and intercept each other in every direction; of a brown hue externally, but perfectly transparent and colorless when reduced to thin laminæ; rarely also in separate crystals, in the form of a doubly oblique prism, M on T 64° 54′, P on T 101° 20′, P on M 108° 30′.* It scratches glass. Exposed to heat in a matrass, it decrepitates violently, is *dispersed* (hence its name, from the Greek), and splits into small, white brilliant scales, which, B B, with borax fuse readily into a colorless glass. Berzelius says that these small scales restore the blue color of reddened litmus paper; but Mr. Children did not find this to be the case with the specimen which he examined. When digested in muriatic acid, it becomes colorless, the oxide of iron being dissolved, but the mineral itself remaining unchanged.

The oblique edges of the prism are sometimes replaced by a single plane, probably a tangent plane, but it is not sufficiently smooth for measurement.

It is described as occurring only near the village of Kosoibrod in the Orenbourg government of Asiatic Russia, where it forms veins in primary limestone. Its superior lustre distinguishes it from the last species, some varieties of which it nearly resembles.

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* According to Mohs, it is a rhombic prism of about 130°.

GIBBSITE.[*]

Hydrate of Alumina. Gibbsite, *Torrey*. *Cleaveland.* Hydrolus Gibbsianus, D.

Combination of alumina and water. Analysis by Dr. Torrey: Alumina 64·8, water 34·7. It is a simple hydrate of alumina. Specific gravity 2·4; hardness between 3·0 and 3·5.

It is described as commonly occurring in aggregations of irregular stalactites from 1 to 3 inches in length, and not less than an inch in diameter; and sometimes in a botryoidal crust lining the cavities of the hematite iron ore, in connection with which it occurs. Structure indistinctly fibrous, fibres radiating from the centre; a little harder than calcareous spar, but easily reduced to powder; slightly translucent, and lustre faint; color greenish- or greyish-white. B B, it whitens but is infusible; yields in the matrass much water, but does not effervesce with acids.

This mineral was first discovered by Prof. Emmons in the beds of hematite iron ore in Richmond, Mass. More recently it has been found in a similar ore bed in the neighboring town of West Stockbridge, where Prof. Hitchcock has observed it in the form of delicate needles implanted on the hematite; and also under the same circumstances in Lenox, Mass. It was analyzed at about the same time by Dr. Torrey and Prof. Dewey, both of whom found it to be a pure hydrate of alumina. Dr. Thomson has since analyzed what must have been an impure specimen, as he is himself inclined to admit; for his results give, besides alumina and water, nearly 9 per cent of silica and 4 of peroxide of iron.

HYDRARGILLITE.

This mineral has been described by Prof. G. Rose in *Pogg. Ann.* xxxvii. 277. It has not been analyzed, but appears to be, as its name indicates, a pure hydrate of alumina, analogous to Gibbsite. But it occurs in regular crystals, or six-sided prisms terminated by single plane faces, with their lateral edges replaced. Surfaces streaked. Cleaves parallel to the terminal faces. Terminal faces possess a pearly lustre, while the lateral faces have a feeble, vitreous lustre. Color reddish-white. Hardness little less than that of calcareous spar, which scratches easily the terminal planes, but less easily the lateral ones. Specific gravity not stated. B B, it becomes white and opake, exfoliating without melting. It gives out an intense light without coloring the flame. Heated in a close tube, it gives out abundance of water without any re-action, and the presence of hydro-fluoric acid cannot be discovered in the tube. With borax and salt of phosphorus it produces readily a limpid pearl. With boracic acid and iron it does not produce the re-action of phosphorus. Does not melt with soda. With nitrate of cobalt it gives a beautiful blue color.

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[*] In honor of the late Col. George Gibbs, who was so well known for his zeal and munificence in the cause of science.

The locality of this mineral is Achmatowsk, near Statoust in Siberia. There is a mineral found on the hill of Beaux, near Arles, which resembles the hydrargillite and has been described and analyzed by Berthier.* It is a hydrate of alumina of nearly a blood-red color, but it is not crystallized, and occurs more nearly in the form of Gibbsite. It is mechanically mixed with oxide of iron.

HYDROUS TRISILICATE OF ALUMINA.

Kollyrite, L. Alumine Hydraté Silicifère, *Levy.* Hydrolus Argilliformis, D.

Alumina	45·0	44·5
Silica	14·0	15·0
Water	42·0	40·5
	101·0 Klaproth.	100·0 Berthier.†

The atomic proportions, as deduced from these analyses, show the mineral to be a hydrous trisilicate of alumina. —*Thomson.* Formula, Al^3S+5Aq.

Sp. Gr. 2·06 to 2·11. H. = 3·25.

This mineral occurs in white and nearly opake masses, which are perfectly sectile. When broken, it presents an earthy fracture, with a somewhat vitreous lustre.

It dissolves without effervescence in nitric acid, and is converted into a saline magma without crystals; but is not affected by the blowpipe. When calcined, it gives off much water, separates into columnar masses like starch, and loses weight; adheres to the tongue, absorbs water with a slight noise, and becomes almost transparent.

It occurs at Schemnitz in Hungary, and in the gallery of a lead mine on the bank of the river Oo, in the Pyrenees.

The following are similar compounds, and most probably mere varieties of this species, differing in the proportions of their constituents, and in containing some accidental admixtures:

1. Severite. Analysis by Pelletier: alumina 22, silica 50, water 26, loss 2. It occurs in small masses of a white color, without lustre, but possessing a slight degree of translucency; occasionally it is semi-transparent. It is a little harder than lithomarge, which it somewhat resembles. The surfaces produced by fracture are dull; it is extremely brittle, and yields easily to the knife; is soft, but receives a high polish by friction; adheres strongly to the tongue, and emits no argillaceous

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* Ann. des Mines, v. 531.

† Ann. de Chim. et de Phys., vi., 333.

odor when breathed on. It does not effervesce with acids, nor form a paste with water. It was found by M. Dufour in the neighborhood of St. Sever* in France, in a gravelly soil, in masses from 2 to 4 or 5 inches in diameter.

2. **Lenzinite.**† — *John.* It has been divided into two varieties, the opaline and the argillaceous, the first consisting of alumina 37·5, silica 37·5, water 25·0, and a trace of lime. Of a milk-white color; to the touch smooth and slightly greasy; surface not shining; fracture large and flat conchoidal; translucent, or transparent on the edges; sectile; easily reducible to a white powder; adheres to the tongue. Specific gravity 2·1. In water it separates into numerous pieces, which are nearly transparent, and which, on the slightest touch, fall into small hard grains.

The argillaceous variety consists of alumina 35·5, silica 39·0, water 25·0, lime a trace. — *John.* Color snow-white; occasionally tinged yellow by oxide of iron; dull, with an earthy fracture, and slight coherence. In minute pieces only it is slightly translucent; it becomes shining and unctuous by friction, and strongly adheres to the tongue. Its specific gravity is 1·80. Placed in water, it breaks down with much sediment, but less than that of the opaline, without increasing its transparency. Exposed to a red heat, it becomes hard enough to scratch glass, but undergoes no other change. Both varieties occur at Kall in Eifeld.

Dr. Thomson is led by analysis and other characters to regard both this mineral and severite as varieties of halloylite, which last, with scarbroite, he makes into two other species. He has also added to the class of hydrous aluminous minerals a few others, for which he has proposed new specific names: as Gilbertite, Hydrous Bucholzite, Tuesite, Hydrous Bisilicate of Magnesia, and Quartersilicate of Alumina. A part of these have been transferred to this work, but it does not appear certain that the others are strictly definite combinations.

3. **Allophane.** *Stromeyer.* (*Gilbert's Annalen*, liv., 120.) Alumina 32·202, silica 21·922, water 41·301, lime 0·730, carbonate of copper 3·050, sulphate of lime 0·517, hydrate of iron 0·270.

This mineral was analyzed three different times by Stromeyer, with almost precisely the same results, showing a constancy in the proportions of its constituents. It is sometimes described as a distinct species, and Dr. Thomson thus records its formula from the first analysis: $2AlS+Al^2S+10Aq$.

Sp. Gr. 1·8 — 1·9. H. = 3·0.

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* Whence Severite.

† Named in honor of Lenz, a German mineralogist.

It occurs in translucent masses, possessing a somewhat vitreous lustre, and a pale blue, green, or brown color; it is extremely brittle, but may occasionally be cleaved into prisms, which apparently are rectangular. B B, it intumesces without fusing, and falls into powder, communicating to the flame a green tinge; with borax it melts into a colorless glass, and in acid it gelatinizes. It occurs at Saalfeld in Thuringia, at Gersbach in the Black Forest, in the Upper Palatinate, and at Schneeberg in Saxony.

4. Scarbroite. Contains alumina 42·75, silica 7·90, water 48·55, peroxide of iron 0·80. — *Vernon*. Sp. Gr. 1·48. Easily scratched by the knife; massive; color pure white; devoid of lustre; fracture conchoidal; highly adhesive to moist surfaces, and polished by the nail; breathed upon, it emits a strong earthy smell, and when immersed in water neither becomes translucent nor falls to pieces, but gains considerably in weight. It occurs in a calcareous rock on the Yorkshire coast, near Scarborough, between septæ of oxide of iron.

5. Halloysite. Consists of alumina 34·0, silica 39·5, water 26·5. — ***Berthier***. Sp. Gr. 1·8 — 2·1. In compact amorphous masses, having the aspect of steatite; color white, generally with a slightly bluish tint; translucent on the edges; fracture conchoidal, like that of wax; imbibes water, giving off numerous globules of air, and becoming more translucent; adheres to the tongue; yields to the nail, and is polished by it; when exposed to a high temperature it loses in weight, but acquires much hardness, and its color becomes milk-white; sulphuric acid decomposes it readily, dissolving the alumina, and leaving the silica in a gelatinous state.

It occurs along with ores of zinc, iron, and lead, in the vicinity of Liège and Namur; and, according to Boussingault, also in the province of Bogota, in New Granada. It was described as a new species by Berthier, and named by him in honor of his uncle, M. Omalius d'Halloy, who first noticed it. (***Allan's Manual.***)

KYANITE.

Sappare, *Saussure*. Kyanit, W. Disthène, H. Prismatic Disthene Spar, M. Rhætizite. Fibrolite. Ephimecius Cyaneus, D.

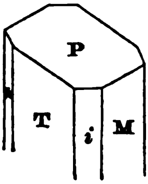
Combination of alumina and silica.

		Var. Fibrolite.		*White,*
	St. Gothard.	Carnatic.	Norway.	Zillerthal.
Alumina	55·50	58·25	62·5	67·8
Silica	43·00	38·75	37·0	31 6
Oxide of iron	00·50	00·75	0·0	0·0
	99·00 Klaproth.	97·00 Chenevix.	99·5 Arfwedson.	99·4 Beud.

The mean of four accurate analyses by Arfwedson, gave silica 36·66, alumina 63·97, which divided by the atomic weight, gives 1 atom silica, 1½ atom alumina: formula, $Al^{1\frac{1}{2}}S$.

Sp. Gr. 3·5—3·7. H. = 5·0—7·0.

Primary form a doubly oblique prism, of which the terminations are nearly rhombs; cleavage parallel to the planes of the prism, with difficulty parallel to those which may be considered as the terminal. The angles of the prism are 106° 15′ and 73° 45′; of the terminal plane on the prism, in one direction 100° 50′ and 79° 10′, and in the other 93° 15′ and 86° 45′. Generally occurs in irregularly terminated four-sided prisms. Its colors are white, grey, and blue.* It has sometimes a greenish tinge; the grey and blue are often intermixed in the same crystal; lustre pearly; the edges of the crystals scratch glass, but the broad surfaces yield to it. Some crystals by friction acquire negative electricity, others positive.† B B even its powder is infusible, and it remains unaltered in very high degrees of temperature; with borax it fuses slowly into a transparent colorless glass, and with salt of phosphorus forms a translucent silica skeleton, and a glass which does not become opaline on cooling. Is not acted upon by acids.



M on T	106°	15
P on M	100	50
—— T	93	15
—— *i*	97	48
—— *k*	83	88
M on *i*	145	16
T on *i*	140	55
—— *k*	122	20

It occurs only in primitive rocks. In St. Gothard in mica slate, associated with garnet, staurolite, and quartz; in the Sau-alp in Carinthia, with garnet, actynolite, &c.; in the Tyrol with quartz and hornblende; in very large crystals in Bohemia; at Villa Ricca in South America. In the United States exceedingly rich and beautiful, at Litchfield, Washington, Plymouth, and Oxford, Conn.; Chesterfield, Mass., in mica slate, and Charlestown, N. H., in quartz. At Chesterfield prisms are sometimes met with two feet long and nearly two inches wide.—*Webster.* At Windham, Me., it is very abundant, and of fine color, in a vein of quartz which traverses mica slate, and it is accompanied by staurotide, especially near the walls of the vein.—*Cleaveland.*

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* Whence Kyanite, from the Greek, signifying blue.

† Hence the name Disthene was given by Haüy to this mineral, on account of its double electric powers.

Rhætizite is a nearly white or somewhat reddish variety in aggregated masses, from the Pfitsch-thal in the Tyrol.

When in sufficiently large masses, of a fine blue color and transparent, this species is cut and polished as an ornamental stone, bearing some resemblance to sapphire.

Fibrolite. With this mineral should now be classed *fibrolite*, which was before described as a distinct species. They agree in chemical composition and in their characters B B; nor is there any thing in the crystalline structure of the fibrolite to oppose the union, so far as this structure has been developed. The principal authority we have for uniting them is Prof. Vanuxem, who experimented on the kyanite from St. Gothard, from Chesterfield, Mass., and a fibrolite from Wilmington, Del. He thus states their composition.*

	St. Gothard.	Chesterfield.	Wilmington.
Silica	42·00	42·56	42·77
Alumina	57·50	57·00	55·50
Loss	00·50	00·44	01·73
	100·00	100·00	100·00

These results very nearly accord with those obtained by Chenevix of the analysis of the Carnatic fibrolite.

Fibrolite is white, or of a greenish-grey color, and sometimes of the lustre of pearl and water blended. It is fibrous,† harder than quartz, giving sparks with steel. The fibres of which it is composed are rarely so large as to present any very determinate form, and are obliquely traversed by cracks. It is infusible; acquires a sensible resinous electricity by friction, and emits a reddish phosphorescent light when two pieces are rubbed together. It is found accompanying crystals of corundum in the Carnatic, and as a component part of the granite which is the matrix of that of China. It was first described by Count Bournon. In the United States, it is found at Lancaster, Mass., in mica slate, in a fibrous form, and also in long bladed or foliated prisms; and at Walpole, N. H., in mica slate; at Bellows Falls, in gneiss, according to Dr. Jackson. In Scotland, it occurs at Botrifiny in Banffshire in gneiss; in primitive rocks near Banchory in Aberdeenshire; and in mica-slate in Mainland, Shetland.

WORTHITE.

This mineral was discovered in 1830, by Von Worth, Secretary of the Imperial Mineralogical Society of St. Petersburg. It has been twice analyzed by Dr. Hess, who named it in honor of Von Worth.[*] The following are his mean results: silica 40·79, alumina 53·06, magnesia 0·88, water 4·63.

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* Jour. Acad. Nat. Sci., Philad., vi. 41.

† Whence fibrolite.

These results, including the magnesia with the alumina, give very nearly five atoms silicate of alumina, one atom hydrate of alumina. Formula: $5AlS+AlAq$.

Sp. Gr. 3·1. H. = 8·5.

It is found in rolled masses or boulders destitute of any regular crystalline structure, but sometimes presenting very small, apparently four-sided prisms, or plates similar to common kyanite; a mineral with which it is classed by some authors, but from which it differs in containing essentially combined water, and in its much superior hardness. It is translucent, of a white color, vitreous lustre, and is harder than quartz, or even topaz. When heated in a matrass it gives off its water and becomes opake. B B, alone, on charcoal, it is infusible. With borax it dissolves very slowly, and with carbonate of soda it intumesces, but the assay does not fuse completely in the strongest heat. Moistened with nitrate of cobalt and strongly heated, it gives a beautiful dark blue. This mineral occurs near St. Petersburg, and on the shores of the Bay of Finland.

BUCHOLZITE.[†]

Brandes, (*Schweigger's Jour.*, xxv. 125.) Anhydrous Silicate of Alumina. *Dr. Thomson*, (*Trans. Roy. Soc. Edinb.*, xi. 263.) Epimecius Bucholzianus, D.

Combination of alumina and silica.

	Tyrol.	Chester, Penn.	Xenolite.
Silica	46·0	46·40	47·44
Alumina	50·0	52·92	52·54
Potash	1·5	0·00	0·00
Protoxide of iron	2·5	traces	0·00
	100·0 Brandes.	99·32 Thomson.	99·98 Komonen.

The atoms of silica are 23·46, while those of the alumina are 23·43, showing that the mineral is evidently a simple anhydrous silicate of alumina. Formula: $AlSi$, or $\dddot{Al}\,\dddot{Si}$.

Sp. Gr. 3·19. H. = 6—7.

This mineral is amorphous, spotted white and black, with a glistening lustre, which is waxy, pearly, or vitreous; separating into fibres, especially in the black part, but in the white and grey the texture is often with difficulty perceivable. The cross fracture is occasionally conchoidal. The fragments are mostly wedge-shaped and sharp, and when thin are slightly translucent.

Specimen from Chester; color greyish-white, with a slight tinge of yellow; structure fibrous, the fibres sometimes bent,

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[*] Transactions of the Imperial Soc. of St. Petersburg, vol. i. part i. p. 76.

[†] So named in honor of Bucholz the chemist, by Brandes, its discoverer.

ıen viewed through a microscope assuming the appear-
' imperfect prismatic crystals; lustre silky.
ıs first found at Fassa-thal in the Tyrol, by Dr. Brandes.
United States it is found at Chester, on the Delaware
'enn.; also at Humpreysville, Ct., and, according to Dr.
, at several places in Monroe, Orange county, N. Y.

ɔLITE was discovered by Von Worth, near Petershoff, in
s, on the shores of the Bay of Finland, and was named
denskiöld, from ξενος, a stranger.* Its color is white,
and yellowish, and externally it very much resembles
te; is translucent, has an uneven fracture, and a vitre-
tre; is in fibrous masses, which sometimes divide into
ded prisms, two sides of which form an angle of 45°
l the third appears to be at right angles with one of the
In its blowpipe characters, and chemical composition,
s with Bucholzite; and its complete identity with that
, was first pointed out by Mr. Teschemacher, in the
f the Boston Soc. of Natural History, for May, 1843.

STAUROLITE.

W. Staurolite, H. Prismatoidal Garnet, M. Carbunculus decussatus, D.

'ombination of alumina, silica, and oxide of iron.

	Bretagne.	St. Gothard. *Reddish-brown.*	*Blackish-brown.*
lumina	44·00	39·88	41·00

and in the apparently pure varieties, a conchoidal fracture. B B, it assumes a darker hue, but, *per se*, does not fuse; with borax it melts slowly into a transparent deep-green colored glass.

1. 2. 3. 4. 5.

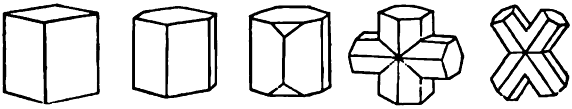
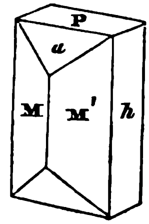


Fig. 1, the primary form; a right rhombic prism. Fig. 2, the same, of which the acute edges are replaced by planes, forming a six-sided crystal. Fig. 3 differs only from fig. 2 in having the obtuse solid angles replaced by triangular planes. Fig. 4, a macle, consisting of two crystals resembling fig. 2, crossing each other at right angles. Fig. 5, a macle, in which the crystals cross each other at a different angle.

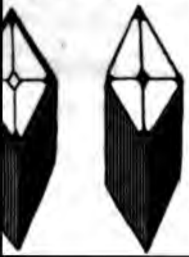


M on M'	129°	20'
P on M or M'.	90	00
M or M' on *a*	137	58
M' on *h*	115	18

The staurolite belongs to primitive countries. It occurs in the form of fig. 2 at St. Gothard in Switzerland, accompanying kyanite, and imbedded in talc slate; also in the Greiner Mountain, Tyrol: macles of considerable size, superficially of a dull brown color, and opake, are met with in Bretagne in micaceous clay, considered to be the debris of a primitive rock. Several other varieties occur at Compostella in Spain, in some of the Hebrides, generally dark colored and opake.

It is an abundant mineral in the United States, usually in mica slate. In Windham, Me., single prisms, double prisms, crossing at right and oblique angles, and even three prisms intersecting each other, sometimes all occur in the same specimen. —*Cleaveland.* At Sheffield, Northfield and Cummington, Mass., Litchfield, Ct., in well characterized specimens. On the Wichicon, near Philadelphia, in reddish-brown six-sided prisms, with dihedral summits, associated with kyanite and garnet.—*Lee.* At Mink Cove, Lisbon, N. H., finely formed crystals are found both loose and imbedded in mica slate. At Charlestown, N. H., the same rock contains hemitrope crystals bling andalusite, but preserving the distinct angles of lite. When the slate becomes argillaceous, the mineral, erved by Dr. Jackson, appears to pass into andalusite by gradual changes.

AUROLITE MACLE.[*] This name has been given by Dr. on to a variety of this species which is remarkable esenting a structure similar to that of andalusite ma-hile it preserves the angles and general character of lite. The macles are generally crossed at the natural of the crystal, by two black lines passing along the nals of the rhombic prism, while a small central rhomboid is formed at the centre, where the two intersect. The crystals are frequently surrounded by ler, pearly crust, which Dr. Jackson regards as a hydrous variety of andalusite. The two annexed figures represent the common appearance of these macles when their faces, obtained by cross-sections, have been ground down and polished. In the most perfect specimens, the entire rhomboidal crystal is enveloped by a uniform coat of black, fine-grained clay slate, and the interior substance is of a reddish-yellow color,



Charlestown and Walpole, N. H., and it is accompanied by garnets. According to Dr. Jackson, these staurolite macles pass by imperceptible shades into andalusite macles, ***when the micaceous slate passes into argillaceous slate.***

AUTOMALITE.

Automalith, W. Spinelle Zincifère, H. Octahedral Corundum, M. Gahnite. Sapphirus Eutoma, D.

It consists essentially of alumina and zinc.

		Fahlun.	America.
Alumina	60·00	55·14	57·09
Silica	4·76	3·84	1·22
Oxide of zinc	24·25	30·02	34·80
Protoxide of iron	9·25	5·85	4·55
Magnesia	0.00	5·25	2·22
	98·25 Ekeberg.	100·10 Abich.	99·68 Abich.

Beudant adopts the first analysis, which gives the atomic ratio of the alumina to the oxide of zinc, as 6 to 1. The two last Dr. Thomson thinks are the most entitled to confidence, and these, rejecting the iron and manganese, give us 4 atoms of alumina to one of oxide of zinc, which he regards as the true composition of the mineral. Formula: ZAl^4.

Sp. Gr. 4·1 to 4·3. H. = 8·0.

Automalite by some mineralogists is considered a variety of spinel; and as it contains so large a proportion of the oxide of zinc, it has been designated *Zinciferous Spinel;* sometimes it is called *Gahnite*, in honor of Gahn, its discoverer. It occurs in regular octahedrons, which may be cleaved parallel with all its planes; it also occurs in tetrahedrons of which the angles are replaced; and in macles. It is much heavier than spinel, from which it also differs in being nearly opake, and of a dark bluish-green color by transmitted light, as well as essentially in respect of composition. B B it is unalterable alone, and nearly so with salt of phosphorus or borax.

It occurs in a talcose rock at Fahlun in Sweden, associated with galena, blende, garnet, gadolinite, &c. In the United States, crystals of a large size are found at Franklin, Sussex County, N. J., accompanying quartz, felspar, and Jeffersonite; and in granite associated with chrysoberyl, garnet, and columbite, at Haddam in Connecticut. The most perfect crystals found in New Jersey, have been detached from the matrix of limestone, and are found in alluvial situations. They are occasionally met with from three to four inches round the base, having all their edges emarginated, and presenting a beautiful indigo-blue color by transmitted light.

DYSLUITE.

*W. H. Keating.** Sapphirus Infusilis, D.

This mineral is by some supposed to be a mere variety of zinciferous spinelle, in which a large portion of oxide of zinc is replaced by protoxide of iron. It has the same crystalline form as automalite, but differs essentially in many of its physical characters. Dr. Thomson has analyzed it and obtained these products:

Alumina	30·490
Oxide of zinc	16·800
Peroxide of iron	41·934
Protoxide of manganese	7·600
Silica	2·966
Moisture	0·400
	100·22

In other trials he found no silica, and rejecting this as accidental, the mineral appears to be composed of simple aluminates; the alumina, as in other cases, acting the part of an acid, and giving 5 atoms aluminate of iron, 2 atoms aluminate of zinc, 1 atom aluminate of manganese. Dr. Thomson observes that it offers the only example known, in the mineral kingdom, of a congeries of simple aluminates. Formula: $5\underset{\cdot}{F}\dddot{A}l+2\underset{\cdot}{Z}\dddot{A}l+1\underline{M}n\dddot{A}l$.

Sp. Gr. 4·5. H. = 4·551.

Its color is usually yellowish-brown, varying in intensity in different crystals. Lustre vitreous, inclining to resinous. Streak paler than the color. Fracture conchoidal. Opake, or sub-translucent. Easily frangible. The crystals are very splendent when the faces are very smooth, which is usually the case.

Primary form a regular octahedron, parallel with the faces of which it presents imperfect cleavages. The crystals are modified on their edges by single replacements.

B B, it assumes a red color which it loses on cooling, and the assay remains unaltered in its appearance. When heated on charcoal it becomes darker colored, but does not melt. With carbonate of soda it does not fuse, but the soda while in fusion has a fine red color, which it loses on cooling. With biphosphate of soda, no fusion, but the salt when melted assumes a fine red color, which changes to a yellow on becoming solid, and when cold it resumes its white color and transparency, the assay remaining unaltered in the centre. In borax it dissolves very slowly. The bead is transparent, and has a very deep garnet-red color.

This mineral occurs at the Sterling zinc mine, Sussex

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* Jour. Acad. Nat. Sci., Philad., vol. ii., p. 287.

County, N. J., associated with Franklinite and the other well known productions of that place. The best crystals are imbedded in calcareous spar.

KÄMMERERITE.[*]

Nordenskiöl. (*Trans. Russian Imp. Min. Soc., for* 1842, *p.* 80.)

This is a violet blue mineral, which accompanies the Uwarowite from the Ural mountains. It has been carefully described both by Von Worth and Nordinskiöld in the Transactions above named, in which its analysis by Hartwall is also thus stated:

Silica	37·0
Alumina	14·2
Oxide of chrome	1·0
Magnesia	31·5
Lime	1·5
Water	13·0
	98·2

Sp. Gr. 2·640. — H. = 2 — 2·5.

It is described as resembling in its most compact form, fluor spar, though usually composed of fine laminæ, like lepidiolite. Colors, sometimes dark-violet blue, sometimes yellowish, greenish or greenish-white. Translucent on the edges, particularly after being immersed in water. Fracture compact, fine grained, becoming splintery or leafy in the less compact varieties; flexible. Dull, or of a greasy lustre, often glistening. When scratched, it gives a light, peach blossom-red, or almost white streak. The common form of its crystal is a hexahedral prism, presenting a perfect cleavage perpendicular to its axis, but yielding in no other direction. A portion of a clear, transparent prism in polarized light, showed a dark cross with the surrounding rings being indistinctly marked; whence Nordenskiöld concluded that its crystallization was rhombohedric. But he did not obtain any measurable planes, and its more complete crystallographical characters yet remain to be determined. The cleavage planes are lustrous, like mother of pearl. The color of some crystals, which by daylight are so dark that the red color can hardly be seen, appears by candle-light quite red, and some parts, which would be taken in the day for chlorite, are red in the night. It is thus dichorous like the Siberian chrysoberyl, but in a less degree.

B B, *per se*, gives water without any trace of acid, becoming darker; swells, but does not fuse even on the edges. In greater heat becomes again reddish, but opake. On charcoal it is infusible, becoming green in the inner flame, and reddish-grey in the outer. With borax in the outer flame it sputters, and then is slowly but perfectly dissolved into a fine chrome-green, transparent vitreous globule. This globule is brownish while hot, and the chrome-green appears first after cooling. With the addition of a little tin the globule becomes of a still more brilliant green. With salt of phosphorus it partially dissolves, leaving a skeleton of silica. With solution of cobalt it shows bluish spots, both in splinters and when powdered. With fluor spar it fuses to a fine turquoise blue globule.

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[*] In honor of M. Kämmerer, Superintendent of the Russian mines.

This mineral occurs in the clefts of the compact chromium ore on the western declivity of Sananowskaja, in the Ural mountains, twelve wersts from Bissensk. No other locality is named.

PYROSKLERITE.*

Von Kobell. (*Berzelius' Jahres-Bericht*, 1835, p. 208.)

This mineral is quite similar to Kammererite in its composition, as appears by Von Kobell's analysis; which gave of silica 37·03, alumina 13·50, magnesia 31·62, oxide of chrome 1·43, protoxide of iron 3·52, and water 11·00. The formula given by Von Kobell, from these numbers, also represents the true composition of the last species described. It is thus stated: $2(Mg\underline{F})S+(AlCh)S+1\frac{1}{2}Aq.$† Specific gravity, 2·74 Hardness between rock salt and fluor spar. Streak white. Fracture uneven and splintery; lustre dull. Color apple-green and emerald-green. In thin edges translucent. B B melts slowly into a greyish glass. With borax dissolves slowly to a chrome-green, transparent glass. Decomposable by, and forms a jelly in muriatic acid. Exposure to a red heat causes it to lose 11 per cent. in weight, and it becomes hard and brittle. It has a crystalline structure, and presents a perfect cleavage in one direction, and a less perfect one at right angles with it.

As this mineral has the same composition as the species just described, and yet differs from it in crystallization, color, and other characters, Berzelius observes that the two minerals may be viewed as isomeric combinations, such as we see in calc spar and arragonite. It came from the Island of Elba, but with what it occurs is not stated.

HYDROUS BUCHOLZITE.

This name is given by Dr. Thomson to a mineral brought from the island of Sardinia, and composed according to the analysis given in Berzelius' Report for 1833,* as follows:

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* From πυϱ, fire, and σκληϱος, hard, alluding to its hardening in the fire.

† The protoxide of iron being replaced by lime and alumina in kammererite.

Silica	41·350
Alumina	49·350
Sulphuric Acid	2·010
Lime	1·105
Water	4·850
	98·665

The atomic constituents into which these results are reducible, are 5 atoms silicate of alumina, 1 atom water; supposing the sulphate of lime to be accidental, and admitting a small excess of alumina. Formula: $5AlS+Aq$.

Sp. Gr. 2·855. H. $=3$.

Color light-bluish green; streak white; powder white. Structure granular, being composed of small scales; brittle. Lustre vitreous; translucent. B B, becomes snow-white, and falls into powder, from loss of water. With carbonate of soda, it effervesces, and forms slowly an opake-white frit, or an enamel, if the quantity of soda be more considerable. With borax it fuses immediately into a transparent bead, leaving a portion of silica undissolved.

PHOLERITE.

This is another hydrous silicate of alumina, which should properly be considered in this place. It has been described and analyzed by M. Guillemin.† Three different specimens gave him as follows:

Silica	42·925	41·65	40·750
Alumina	42·075	43·35	43·886
Water	15·000	15·00	15·364
	100·000	100·00	100·000

Taking the mean of these analyses, the atomic constituents of this mineral approach pretty nearly 1½ atom silica, 1½ atom alumina, 1 atom water; formula, $1\frac{1}{2}AlS+Aq$.

Hardness and specific gravity not accurately given. It has a fine white color, and is formed of small convex scales, having a pearly lustre. It is soft to the touch, and may be crushed between the fingers. It adheres to the tongue. When plunged into water it disengages air bubbles; but does not exhibit the appearance of lenzinite. It forms a paste with water. When heated it gives out water, but is infusible B B, *per se*.

It occurs in the coal formation of Fins, Dep. of Allier, in France, occupying fissures in the strata.

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* Jahres-Bericht, 1833, p. 174.

† Ann. des Mines, xi. 489.

ANDALUSITE.*

, W. Feldspath Apyre, H. Prismatic Andalusite, M. Chiastolite. Macle.
path. Crusite. Micaphyelite. Stanzaite. Andalusius prismaticus, D.

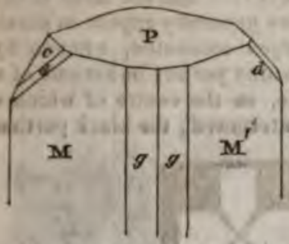
mineral is essentially composed of silica and alumina, ntains several other accidental ingredients. The following analyses have been published.

	Tyrol.	Herzagau.	Lancaster, Mass.
	34·000	36·5	39·09
	55·750	60·5	58·56
	2·000	0·00	0·00
of iron	3·375	4·0	0·00
of manganese.	0·625	0·0	0·53
	2·125	0·0	0·21
	0·375	0·0	0·00
	1·000	0·0	0·99
	99·250 Brandes.	101·0 Bucholz.	98·38 Bunsen.

	Tyrol.	Ireland.	Andalusite, Lancaster, Mass.
	35·304	30·92	33·0
	60·195	64·60	61·0
	0·000	1·75	00·0
of iron	1·324	0·00	4·0
of manganese	0·000	0·50	0·0
	1·000	0·96	0·0
	2·032	0·90	1·5
	99·856 Dr. Thomson.	99·63 Dr. Coverdale.	99·5 C. T. Jackson.

des' analysis gives 2 per cent. of potash, and a specimen ed by Vauquelin gave 8 per cent. But it is evident that kali is rather to be regarded as adventitious, from its va- ess or entire absence, as shown in the analyses. If we te the atomic constitution from the mean of the last

In the Linsenz valley, above Inspruck, in the Tyrol, where it occurs in very large crystals, this species is accompanied with another which presents the same form, and has hence been taken for grey andalusite. But these latter crystals are supposed to be pseudo-morphous, their hardness amounting only to 5·0, while their specific gravity exceeds 3·5.



M on M	91°	20′	91°	33′
P on M or M′ . .	90	00	90	00
—— c	140	00	144	44
M on *g*	145	00	161	43
g on *g*	125	00	123	6[*]

Andalusite was first observed by Count Bournon in a granite mountain in Forez, France, and described by him in the *Journal de Physique*, for 1789. It was soon afterwards found in Andalusia, Spain, whence its name; and also near Braunsdorf in Saxony; at Guldenstein in Moravia; in Bavaria; in the Tyrol; at Killiney Bay, Ireland, and Cumberland, in England.

In the United States, it has been found at Readfield, Searsmont, and Mount Abraham, Me.; both massive and in large and perfect crystals of a pure flesh color, and sometimes with their solid angles replaced, at Westford, Mass. Also in very perfect crystals at Litchfield, and Washington, Ct., and in rough, light-yellowish prisms, near Chester, Penn.

CHIASTOLITE or MACLE.[†] This mineral, described in the former editions of this work as a distinct species, is now to be regarded as a variety of andalusite, both having the same crystalline form and general physical characters, and agreeing also in chemical composition; as has been fully shown by Dr. C. T. Jackson, in a very interesting paper inserted in the *Journal of the Boston Natural History Society*, vol. i. 1834.[‡] Its only peculiarity, is in the singular crystalline arrangement assumed by the separate prisms of the mineral, apparently while imbedded in a soft medium, in which sufficient freedom was not to allow them to unite perfectly, though they seem to have governed by a uniform law of attraction, or groupement, aching each other nearly at right angles. When not at angles, they may have been subject to some disturbing while the rock yet continued soft. The following figures been drawn from several characteristic specimens of this al from Lancaster, Mass. It is rare that the faces of the are of the same length, as they generally appear in paralams, with their entering edges truncated, whence by mode of aggregation, they assume perfect imitations of a as shown by the first figure, in the centre of which a prism of white andalusite is interposed; the black portion

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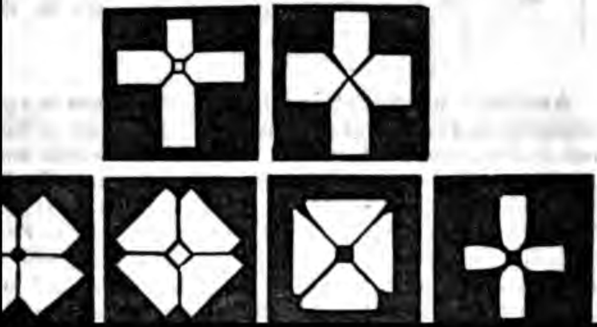
[*] These measurements in the last column, are given in Dana's Mineralogy.

[†] Chiastolite, from the Greek, in allusion to its being marked with the form of an X, in dark lines, visible on the ends of the crystals.

[‡] It should be observed that Beudant proposed to unite these two minerals in the first edition of his Mineralogy (1824); and that in the edition for 1832, he has described chiastolite as a variety of andalusite. These opinions were arrived at independently of each other, but to Dr. Jackson we are indebted for the analysis which fully confirms them.—(AM. ED.)



localities are small compared with those from Lancaster and Sterling, Mass., where the mineral is exceedingly abundant in clay-slate, sometimes approaching to mica-slate. It occurs also in mica-slate at Bellows Falls, Vt., in clay-slate at Charlestown, N. H., and according to Cleaveland, in small quantities at Brunswick, and Georgetown, Maine.

DAVIDSONITE.[*]

This mineral, according to Dr. Thomson, is composed of silica 66·59, alumina 32·12, water 1·30.

Sp. Gr. 2·362. H. = 6·5.

Its color is greenish-yellow; is translucent; easily frangible; brittle. Texture foliated; cleaves in the direction parallel to M of an oblique rhombic prism. The planes are too rough to admit of very accurate measurement, but M on M′ appears to be about 94°, and P on M 100°.

B B, *per se*, it becomes white, but does not fuse. With carbonate of soda fuses imperfectly into a white enamel. With borax it fuses into a transparent colorless glass, having a silica skeleton in the centre.

It was found by Dr. Davidson in the granite quarry of Rubislaw, near Aberdeen, constituting a detached mass in the rock. It is intimately mixed with thin plates of mica, from which it is so difficult to separate it, that the fullest confidence cannot be had in the analysis of the mineral.[†]

STELLITE.[‡]

Dr. Thomson. (*Outlines of Mineralogy*, &c., vol. i., p. 313.)

This mineral was discovered by Dr. Thomson and his son, in the greenstone trap situated on the banks of the Forth and Clyde Canal, in Scotland. It is composed, according to his analysis, of

Silica	48·465
Lime	30·960
Magnesia	5·580
Alumina	5·301
Protoxide of iron	3·534
Water	6·108
	99·948

Its atomic constitution, as stated by Dr. Thomson, is 4 atoms bisilicate of lime, 1 atom bisilicate of magnesia, 1 atom silicate of alumina, $2\frac{1}{2}$ atoms water. Formula: $4CS^2+MS^2+AlS+2\frac{1}{2}Aq$. It differs from the zeolites in containing no alkali, and so large a portion of lime in the place of alumina; from thomsonite, which it most resembles, it may be distinguished by its inferior hardness, and by blowpipe characters.

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[*] In honor of Dr. Davidson, Professor of Natural History, Aberdeen.

[†] Berzelius (Jahres-Boricht, 1838, p. 231) says that this mineral has been shown by Lampadius, to be a variety of emerald.

[‡] Named from stella, a star, because the crystals are spread out, in a starlike form, on the rock in which the mineral occurs.

Sp. Gr. 2·612. H. = 3·25.

Color snow-white; lustre silky, shining; translucent; tough, having some slight resemblance to asbestus, or still more to nemalite; B B, fuses into a beautiful white enamel; with carbonate of soda fuses with effervescence into a transparent white bead; with borax, into a perfectly transparent glass when the quantity of stellite is small; if it be larger, the bead exhibits a silica skeleton.

It consists of a congeries of small crystals, issuing like rays from several centres, and these different circles run into each other; so that the termination of each crystal is confused. They seemed to be oblique four-sided prisms, but their angles could not be measured. An interesting fact, therefore, in the character of this mineral, remains to be determined.

Professor Beck, in his report on the *Mineralogy of New York*, p. 343, has described and given the analysis of a mineral manifestly very similar to the stellite. It was found in the trap rocks of Bergen Hill, N. J., and Piermont, N. Y. It has the same external characters, exhibits the same behaviour B B, and differs but little in the proportions of its silica and bases. It should be observed, however, that many of the specimens passing among mineralogists for stellite, from the above-named localities, have the hardness and other characters of thomsonite, and contain soda, which is readily indicated by the blowpipe.

DYSCLASITE.

Connell. (*Trans. Roy. Soc. of Edin.*, vol. xiii., p. 46.) Vulcanus Fenax, D.

The following are the constituents of this mineral, according to the analysis of Mr. Connell:

		Okenite.
Silica	57·69	56·99
Lime	26·83	26·35
Soda and potash	0·67	00·00
Oxide of iron	0·32	00·00
Oxide of manganese	0·22	00·00
Water	14·71	16·65
	100·44	99·99 Kobell.*

Formula, expressing its atomic constitution, as given by the analyst: $5CalS^4+CalS^2+9Aq$.

Sp. Gr. 2·28 — 2·36. H. = 4·5 — 6.

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* Kastner's Archiv., vol. xiv., p. 333.

Occurs in white masses which have an opalescent appearance, and exhibit considerable translucency. Lustre glistening and vitreous. Its texture is imperfectly fibrous, but the fibres in some places diverge with considerable regularity, exhibiting an approach to crystalline structure. It is remarkably tough, and difficultly frangible, so as to require much time and labor to separate a mass into smaller fragments, — from which property its name has been derived. It gives off water at a red heat, and, B B, is *per se* fusible only on the edges, and without intumescence; in soda it yields with effervescence a semi-transparent glass; with borax, and salt of phosphorus, it presents colorless glasses; and with nitrate of cobalt exhibits no re-action of alumina. When reduced to powder it gelatinizes readily with muriatic acid.

This mineral was brought from the Faroe Islands by that active and enlightened cultivator of Mineralogy, Count Vargas de Bedemar, of Copenhagen, to whom we are indebted for so many of the rare and beautiful productions of those regions. It was first distinguished as a new species, by Mr. Connell.

The OKENITE[*] of Kobell (from Disco Island and Tupaursak in North Greenland) is undoubtedly identical with this species, as both occur under the same form, have the same composition, and are associated with minerals of the same class. Berzelius has at once united them, and cites the dysclasite as a new locality of okenite, giving preference to the latter name probably on account of its priority.[†] The great tenacity observed in the former mineral does not seem to have been noticed in the latter, and is therefore to be attributed to something independent of its chemical composition.

HAYDENITE.[‡]

Cleaveland. (Mineralogy, Second Edition, 1822; p. 478.)

This mineral has usually been described as a variety of chabasie by the mineralogists of this country (U. S.), even in the latest treatises on the science, notwithstanding that the description given by Cleaveland was such as to give it strong claims to the distinction of a new species. No further examination was made of it until 1839, when its crystallographical characters were fully investigated, and the evidence of its distinct nature satisfactorily determined. For this we are indebted to the late crystallographer, M. Levy.* The mineral has not, however, been analyzed. The following comprises the essential points in M. Levy's description:

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[*] In honor of Prof. Oken, of Munich. [†] Berzelius. Jahres-Bericht, 1835, p. 221.

[‡] Named in honor of Dr. H. H. Hayden, of Baltimore, by whom it was discovered.

Sp. Gr. not given. H. = 4.

It is regularly crystallized, the crystals having the form of small oblique rhombic prisms, in which the incidence of the lateral faces is 98° 22′, and the incidence of the base on each of the lateral faces is 96° 5′. They are frequently macled, and the axis of revolution, around which one of the two crystals forming the macle is supposed to have turned 180°, is perpendicular to the base of the primary form (oblique rhombic prism), and the face by which the two crystals are united is parallel to the same base. The crystals are thickly grouped together, occupying the spaces in the narrow fissures of the rock, which readily separates into layers having both surfaces coated with this mineral and the pearly heulandite already described. No modifications, either upon the edges or angles, have been observed; so that the relation between the sides of the base and the lateral edges remains undetermined. Cleavage, apparently with the same facility, parallel to every face of the primary form. The cleavage planes sometimes present an uneven surface on account of dark spots, as if the substance had suffered incipient decomposition. The crystals are usually covered by a thin layer of hydrate of iron, which seems to be the result of the decomposition of the mineral. This is readily detached by the knife, and the planes thus exposed are sufficiently brilliant to be measured by the reflecting goniometer. Color is brownish-yellow or greenish-yellow; the crystals, which are all either translucent or transparent, are readily scratched by the knife, and very friable. B B, a pure crystal, freed entirely from its ferruginous covering, fuses with some difficulty without intumescence, and accompanied by slight phosphorescence, into a white, blebby, opaline globule; and with its own bulk of borax, into a perfectly transparent glass. It gives out little or no water in the bulb-tube. These characters sufficiently distinguish this mineral from chabasie, and it probably contains a much smaller proportion of lime. It is soluble in sulphuric acid or muriatic acids, and the solution yields small white prismatic crystals, almost equal in mass to the quantity dissolved. The presence of potash is readily shown by the precipitate thrown down by chloride of platinum.

According to Dr. Hayden, this mineral is found at Jones's

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* Paper read before the French Academy of Sciences, and inserted in "L'Institut," No. 313. See also Lond. and Edin. Phil. Mag., vol. xvi., 1840, p. 156. [Am. Ed.]

Falls, near Baltimore, Md., in the fissures of gneiss. It is associated with heulandite, stilbite, and small lenticular crystals of carbonate of iron; the largest crystals vary from ⅛ to ¼ of an inch across their planes. The fact stated by M. Levy, that he had observed no modifications of the crystals of haydenite,* is at the present time worthy of special notice, as a large number of specimens have since been examined, without any evidence of such modifications.

ANHYDROUS SCOLEZITE.†

Nordenskiöld, Bidrag, p. 67.

This mineral occurs in the large masses of scapolite at Ersby, in Finland. It was taken for scapolite until its analysis by the chemist above named, proved that it could not be that mineral, and induced him to constitute it a peculiar species. It occurs crystallized, but the form of the crystals has not been stated by Nordenskiöld. Presents one cleavage.

Sp. Gr. not given. H. = 6.

Its color is white; lustre vitreous; translucent; fracture small conchoidal; B B, its behaviour is like that of common scolizite, except that more heat is required to fuse it into a glass with soda. The constituents are as follow:

Silica	54·13
Alumina	29·23
Lime	15·46
Water	1·07
	99·89

They give 3 atoms silicate of alumina, 1 atom tersilicate of lime; the water being considered as accidental, not constituting an atomic proportion.

VERMICULITE.‡

Dr. Thomson. (*Outlines of Mineralogy*, vol. ii., p. 373.)

This mineral has been included by some under the species talc, but its composition agrees with no variety of that mineral, and it seems proper to describe it by itself. Dr. Thomson obtained the following results: silica 49·08, magnesia 16·964, peroxide of iron 16·12, alumina 7·28, water 10·276. Formula: $2MgS^2+AlS^2+FS^2+3Aq$.

Sp. Gr. 2·525. H. = 1.

It is composed of shining, micaceous-looking plates, cemented together by a whitish matter; lustre soapy; feel

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[*] He had seen only three specimens.

[†] From δκωληξ, a worm; alluding to the appearance assumed by the mineral B B.

[‡] From vermis, a worm, because it twists itself up like a worm when heated to redness.

greasy; sectile. When heated to redness it projects out with a vermicular motion, as if it were a mass of small worms, and becomes of a silvery aspect, with a shade of red or yellow; it is infusible *per se*, B B; with carbonate of soda in the reducing flame gives a greenish, in the oxidizing flame an amethystine colored glass.

This mineral was sent to Dr. Thomson by Prof. Holmes of Montreal, and it came from Vermont, but unfortunately its locality is not given. There has recently been found at Millbury, Mass., a mineral which Mr. Teschemacher has recognized as vermiculite, from the similarity in its physical properties, and in its behavior B B. According to Hayes, it gives a greenish glass with borax in the reducing flame, and with salt of phosphorus gives a skeleton of silica; alone, increases to about twenty times its size, exfoliating into laminæ, and in the glass tube gives off water. It has not been analyzed.

ONKONSITE.

This is a mineral described and analyzed by Von Kobell. He has named it from its property of swelling up[*] at a red heat, a character which is possessed to the same extent by several other minerals, and which should not be too much relied upon in establishing new species. The following are the results of his analysis:

Silica	52·52
Alumina	30·88
Magnesia	3·82
Protoxide of iron	0·80
Potash	6·38
Loss	4·60
	99·00

Von Kobell adds a formula; but Berzelius says that the analysis allows no formula, and thinks that the mineral must have been a mixture.[†]

Sp. Gr. 2·80. H. between rock salt and calc-spar.

The color is bright apple-green, sometimes grey or brownish; lustre greasy; translucent; fracture imperfectly conchoidal or uneven; structure compact, has no determined crystalline form; B B, readily fusible into a transparent glass; gives in the alembic a little water; is dissolved slowly but completely with borax, the globule opalizing in cooling; it is not decomposed by muriatic acid before or after exposure to heat, but is so by sulphuric acid. While fusing B B, it loses 4·6 per cent.

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[*] From ονκοδιϱ, swelling up.

[†] Jahres-Bericht, 1835, p. 210.

This mineral is found in a kind of micaceous dolomite at Possinger in Salzburg. It bears some resemblance to the two previously described species.

HUDSONITE.

Prof. Beck. (*Mineralogy of New York*, p. 405.)

This name has been given by Prof. Beck to a mineral consisting, by his analysis, chiefly of silica and protoxide of iron. It was found by Dr. Horton at Cornwall, Orange County, N. Y., in the vicinity of the Hudson River. It contains silica 37·90, oxide of iron 36·80, alumina 12·70, lime 11·40, magnesia 1·92.

Sp. Gr. 3·50. H. = 4·5 — 5.

Color black, often with a brownish tarnish; streak green; lustre vitreous to resinous; opake. It occurs massive, exhibiting one very perfect cleavage, like some varieties of pyroxene. Alone, B B, it fuses with effervescence into a black bead, which is attracted by the magnet. Its powder, which is green, has its color heightened by exposure to heat. It resembles in composition the mineral called *Polylite* by Dr. Thomson, but contains no protoxide of manganese, to the absence of which, apparently, must be ascribed its different behavior B B, and its inferior hardness. Its crystalline character deserves, from the hands of the gentleman who has proposed it as a new species, further investigation ere its claims to that distinction will be fully admitted.

TOPAZ.[*]

Topaz, W. Silice Fluatée Alumineuse, H. Prismatic Topaz, M. Topazius Rhombicus, D. Fluosilicate of Alumina, *Thomson.*

Combination of alumina, silica, and fluoric acid.

	Brazil.		Saxony.	
Alumina	47·5	58·38	57·45	57·74
Silica	44·5	34·01	34·24	34·36
Fluoric acid.	7·0	7·79	7·75	7·77
	99·0 Klaproth.	100·18 Berzelius.	99·44 Berzelius.	99·87 Berzelius.

Composition deduced from the mean of the above analyses: $3AlS+Al\dot{F}l$.

Sp. Gr. 3·49 — 3·56. H. = 8·0.

The topaz occurs massive, in rounded pieces, and crystallized. General form prismatic, variously and dissimilarly terminated; the prism usually striated longitudinally and modified. Its structure is lamellar at right angles to the axis of the prism; it also cleaves, though with difficulty, parallel to the sides of a right rhombic prism of about 124° 22′ and 55° 38′; and it appears to yield to mechanical division on all the angles of the prism; cross fracture conchoidal, with a shining vitreous lustre; it is sometimes limpid and nearly transparent, or of various shades of yellow, green, blue, or red, and translucent; it becomes electric by heat with polarity, and is easily excited by friction, the opposite terminations of the crystals presenting opposite kinds of electricity. But Haüy has described a crystal which presented negative electricity at both extremities, and the opposite kind in the middle.*

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[*] The name of the island whence this mineral was procured by the ancients.

The pale-greenish and almost transparent topaz of Siberia becomes electric by heat, not by friction; the Saxon topazes of a pale-yellow color, become electric by friction, not by heat, but lose their color when exposed to fire; the deep-yellow topaz of Brazil becomes electric by heat, and red when placed in the fire. B B, on charcoal, it does not fuse, but the faces of crystallization appear covered with minute blisters, which crack as soon as formed; with borax it melts slowly into a transparent glass; its powder gives a green color to the tincture of violets.

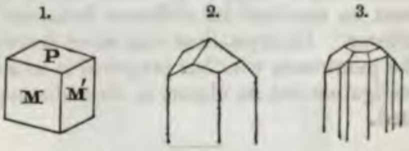

Fig. 1, the primary; a right rhombic prism. Fig. 2, the same, terminated by four planes, of which two replace the acute solid angles, and the other two the obtuse solid angles. In fig. 3, each acute solid angle is replaced by one plane, and each obtuse solid angle by two planes, leaving apparent a portion of the flat summit of the primary prism: there are several modifying planes on the prism itself. The crystals are rarely pyramidal at both ends; when they are so, the terminations are dissimilar.†

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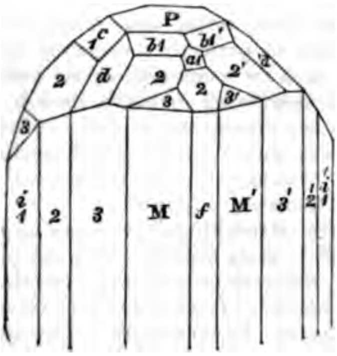
* Sir David Brewster explains this by supposing the crystals to be composed of two, united with their vitreous poles in contact, and thus developing resinous electricity at their opposite ends. A similar phenomenon has also been noticed in a crystal of tourmaline by Prof. Forbes; but, unlike tourmaline, topaz possesses the remarkable property of retaining its excitability long after the temperature has ceased to change. (Lond. and Edin. Jour., vol. v., p. 142.) [AM. ED.]

† The Atlas accompanying the Catalogue of Mr. Heuland's (now Mr. Turner's) collection, and prepared by the late M. Levy, gives figures of eighty-two different forms of this species. See vol. i., p. 260. [AM. ED.]



M on M′	124°	22′	H.
P on M or M′ . .	90	00	"
—— *b* 1	124	36	"
—— *b* 2	135	59	"
M on *i* 1	150	6	"
—— *i* 2	161	16	"
—— *i* 3	169	34	
P on *c* 1	128	26	H.
—— *c* 2	135	59	"
—— *c* 3	117	21	"
—— *d*	138	26	"
—— *b* 1	145	24	"
—— *b* 2	134	1	"
b 2 on *b* 2	140	46	"
b 2 on *b* 3	162	00	
b 3 on *i* 2	148	22	
a 1 on *f*	134	00	
f on *i* 2	122	17	H.
c 2 on *c* 2 over P .	92	45	
d on *i* 2	131	34	H.
b 3 on *a* 2	155	20	

Topaz is almost peculiar to primitive countries. It is not, like quartz, a component part of any particular rock; but at Schneckenstein in Saxony, and in several parts of Cornwall, it occurs associated with tourmaline, quartz, and lithomarge, producing the mixture named, by Werner, topaz-rock. Its usual matrix is granite, accompanying beryl, mica, tourmaline, fluor, apatite, and tin.

The district of Cairngorm in Aberdeenshire has produced the largest and most magnificent crystals of topaz. Jameson mentions one which weighed nineteen ounces; they are usually of a fine sky-blue color, except on the edges of the prism, which appear pale brown; topazes from this locality, however, are rare; in the Ural and Altai Mountains of Siberia they are more common; in Brazil they occur imbedded in an argillaceous earth, resulting, it is believed, from the decomposition of primitive rocks; in smaller crystals topaz is met with in the tin mines of Schlaggenwald and Zinnwald in Bohemia; at Schneckenstein, Ehrenfriedersdorf, and Eibenstock, in Saxony; at St. Michael's Mount in Cornwall, and in other places, with tin. In the Mourne Mountains of Ireland it is found in small but extremely perfect limpid crystals, associated with beryl, albite, and mica, in the drusy cavities of granite. The term *goutte d'eau*, has been applied to those natural stones employed by the lapidary which possess the greatest limpidity, like those from Minas Novas, in Brazil; the larger portion of such as are used in jewelry being more or less altered in color by exposure to heat.

In the United States we have as yet but one locality of topaz, which occurs at Trumbull, Ct., in a vein about a foot in width, accompanied by fluor spar, mica, and, rarely, with wolfram; it affords small druses of perfectly transparent crystals, but the larger crystals, which are sometimes several inches in diameter, have but little transparency or lustre, though, in addition to the lateral faces, they present many of the replacements on the summits that are shown in the accompanying figure. Shepard has given drawings and measurements of three of these crystals in his *Mineralogy*, p. 237.

According to Tavernier, the Grand Mogul possesses an octangular polished topaz of 157¾ carats weight, which was purchased for $60,000: and M. d'Esteuege notices a crystal 10 inches in length and 4 in diameter. (*Feuchtwanger on Gems.*)

1. Pyrophysalite. Physalite. Pyrophysalith.—*Hisinger.* Contains alumina 57·74, silica 34·36, fluoric acid 7·77, being the same ingredients as in topaz, and with very little variation of relative quantity, according to Berzelius. It is in fact a coarse opake variety of topaz, found occasionally in yellowish-white crystals of considerable dimensions, and resembling that mineral in form. Its structure is lamellar in one direction, and splendent; the cross fracture glimmering and uneven; it is translucent on the edges, and not so hard as topaz; specific gravity 3·41; it intumesces when heated,* and gives out a greenish phosphoric light.

It is found at Finbo, near Fahlun in Sweden, in a granite composed of white quartz, felspar, and silvery-white mica. A single well-pronounced crystal, weighing 80 pounds, is preserved in the College of Mines at Stockholm.

2. Pycnite. Schorlartiger beryl, W. Var. de silice fluatée alumineuse, H.

	Altenberg in Saxony.	
Contains Alumina	51·00	49·5
Silica	38·43	43·0
Fluoric acid	8·84	4·0
	98·27 Berzelius.	96·5 Klaproth.

Sp. Gr. 3·51.

Pycnite is a variety of topaz which occurs in long six-sided prisms, deeply striated longitudinally, often closely aggregated† laterally, and exhibiting transverse rents, but without any apparent regular structure; it is usually of a dull, yellowish or reddish-white color, and translucent; is brittle, and may be readily broken across the prism; in other directions its fracture is imperfectly conchoidal, with a shining lustre; scratches quartz; B B, on charcoal, it does not fuse; with borax it melts slowly into a transparent glass; becomes electric on exposure to heat.

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* Whence Pyrophysalite, from the Greek, in allusion to the effect of heat upon it.

† Whence Pycnite, from the Greek, signifying closely aggregated.

It is found entering into the composition of a rock, chiefly consisting of quartz and mica, at Altenberg in Saxony; it is said also to occur in Bavaria, and other places; but Altenberg is its most noted locality.

THULITE.

Brooke. (*Crystallography*, p. 494.) Ceritus Rhombicus, *D.*

The composition of this mineral, which by some is still regarded as a variety of epidote, is not yet satisfactorily determined. According to Beudant (*Traité*, t. ii., p. 73), it consists of silica 42·5, alumina 25·1, lime 19·4, magnesia 0·6. And a more recent analysis by Prof. Esmark, of Christiana,* nearly accords with it as here stated: silica 42·808, alumina 21·144, lime 18·726, soda and potash 1·891, oxide of iron 2·282, oxide of manganese 1·638, water 0·640. This last analysis was made in consequence of Dr. Thomson having announced the presence of cerium in the specimen which he examined. These are the constituents, according to Dr. Thomson: silica 46·10, *peroxide of cerium* 25·95, lime 12·50, peroxide of iron 5·45, potash 8·00, water 1·55.† We shall omit the formula.

Sp. Gr. 3·1. H. = 5·5 — 6.

It occurs in crystalline masses of a rose-red color, the form when visible resembling that of epidote; translucent; streak greyish-white; particles of granular varieties easily separable; cleavage in two directions parallel to the sides of an (oblique?) rhombic prism of 92° 30′, and 87° 30′, according to Brooke; no distinct cleavage transverse to the axis of this prism; B B, it fuses with carbonate of soda into an opake greenish-white bead, and with borax into a colorless transparent bead, which assumes a sensible violet color, if a little saltpetre be added, showing the presence of manganese, as recorded in the analysis by Esmark. It occurs at Tellemarken, in Norway, associated with quartz, fluor spar, and the variety of idocrase termed cyprine.

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* Annales des Mines, tome xvii.

† There is but one locality of this mineral, and I can explain the discrepancy in the analyses only by supposing that two different minerals from the same locality have passed under the same name. [AM. ED.]

MASONITE.

C. T. Jackson. (*Report on the Geological Survey of Rhode Island*, p. 88.)

This mineral has been discovered by Dr. Jackson, extensively distributed in large boulders at Natick and Wickford in Rhode-Island. Its appearance led him to regard it as a new mineral: and subsequently, by an analysis and other examinations of it, he has clearly shown it to be entitled to that distinction. He has thus stated its composition:

Silica	33·200
Alumina	29·000
Magnesia	0·240
Protoxide of iron	25·934
Oxide of manganese	6·000
Water	5·600
	99·974

Sp. Gr. 3·450. Scratches glass.

Its color is brown or brownish-black, with a shining metallic lustre on the faces of cleavage; occurs in masses of a foliated and interwoven structure, sometimes in distinct tabular crystals which cleave very readily perpendicular to their axes, but with great difficulty in the other direction; its primary form appears to be a right rhombic prism, but the specimens have not afforded crystalline planes of sufficient perfection for goniometrical measurement. B B, it fuses with difficulty into a greenish enamel.

It occurs in large rolled masses at the localities above named, associated with garnets and mica: also, according to Prof. Hitchcock, *in situ*, in the town of Ward, Mass., whence Dr. Jackson supposes the scattered fragments may have proceeded. It is named in honor of Owen Mason, Esq., of Providence.

INDIAN PIPE STONE.[*]

Dr. Thomson. (*Outlines of Mineralogy*, &c., vol. ii., p. 287.)

Scoulerite. This mineral, examined and analyzed by Dr. Thomson, came from North America, and is similar to that used by the Indians in making their tobacco-pipes. He obtained it from Dr. Scouler, who had spent a summer on the Northwest Coast of America, between Nootka Sound and the Columbia River; but he was unable to learn from what part of the country it came, or the nature of the rocks with which it was associated. The mean of two analyses gave him,

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[*] Under this head I include two substances, of whose claims as distinct species of simple minerals, I am not fully satisfied. For convenience I have placed them here, though the soda, if it prove essential, may carry one of them into the next class. [Am. Ed.]

Silica	56·11
Alumina	17·31
Soda	12·48
Peroxide of iron	6·96
Lime	2·16
Magnesia	0·20
Water	4·59
	99·81

As many of the physical characters of this mineral seem to show that it cannot be regarded as a definite combination of its constituents, the formula will be omitted.

Sp. Gr. 2·606. H. = 1·5.

Color light greyish-blue; powder light blue; sectile, dull, opake; the particles, when scraped off with a knife, feel gritty between the teeth; it constitutes a compact stone, through which a few scales are scattered, having some resemblance to *claystone*, but being much softer; its fracture is earthy; B B, it is infusible. It is evident that this mineral and the following partake much of the nature of a rock, and that they have not the character of homogeneous, crystallizable minerals, out of which any important set of characters in establishing a species can be drawn.

CATLINITE.—Dr. Jackson* has recently analyzed a substance, used by the northern Indian tribes in the making of their smoking pipes, which he received from Mr. Catlin, the well-known traveller. It was taken from the famous pipe-stone quarry on the *Côteau des Prairies*, in the Sioux Indian country. Though agreeing in some respects with the pipe-stone examined by Dr. Thomson, its analysis shows it to be quite distinct, and it is evident that both minerals could not have come from the same place. Dr. Jackson has given the following analysis of this mineral, and named it in honor of Mr. Catlin, the first white person who visited its locality.

Silica	48·2
Alumina	28·2
Magnesia	6·0
Lime	2·6
Peroxide of iron	5·0
Oxide of manganese	0·6
Water	8·4
	99·0

It cannot be regarded as a substance whose constituents are combined in definite proportions, so as to admit of any certain formula. It seems, in parts, a mechanical mixture of other minerals, sometimes like a fine-grained red sandstone, and frequently it has the appearance of reddle. In its composition it is very similar to fahlunite, as analyzed by Hisinger, yet in physical characters there is scarcely no resemblance between the two minerals.

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* American Journal of Science, vol. xxxvii., p. 392.

Sp. Gr. 2·54. H. = 1·75 — 2.

Its color is brownish-red or brick-red, mottled; streak lighter; is cut with the knife, and may be sawn into slabs with about the same facility as common argillite; feel rather soapy, like steatite; rubbed on white paper it leaves a very sensible brownish-red streak; tough, breaking with an uneven surface in one direction, but in the opposite direction more easily frangible, separating parallel with the natural layers of the rock, which, according to Mr. Catlin, consists wholly of this mineral, and forms regular horizontal strata to a considerable extent. The surface is sometimes glazed, and between the layers small scales of mica may be seen. It is susceptible of a fine polish.

HYDROTALCITE.

This mineral was examined by Carl Hochstetter, at the request of Dr. Marchand, who received it from Prof. Scheerer. It accompanies the steatite from Snarum, and has the appearance of foliated talc. The first result of the examination made known the entire absence of silex, while talc contains a considerable quantity. It is massive, investing steatite in foliated masses; is white, and gives a similar streak, with a pearly lustre; transparent; flexible, with a soapy feel; hardness = 2. Heated in a tube, it gives off much water; at a red heat it becomes reddish-brown, and, when immersed in boiling acids, almost entirely dissolves. Composition as follows:

Magnesia	36·30
Alumina	12·00
Peroxide of iron	6·90
Carbonic acid	10·54
Water	32·66
Insoluble residue	1·20
	99·60

On account of the insufficiency of carbonic acid, the alumina and oxide of iron must act the parts of an acid, and be considered as forming an aluminate with a portion of the magnesia. The combination is so regarded by Prof. G. Rose, who expresses the constitution of the mineral by this chemical formula: $(3\dot{Mg}^2\ddot{C})+(2Mg^3\ddot{Al})+24\dot{H}$. It differs from any other magnesian mineral of its class, especially in the absence of silica, and it has been named hydrotalcite from its general agreement in physical characters with talc, while at the same time it is distinguished from it by the large quantity of water it contains.*

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* Lond., Edin. & Dub. Phil. Jour. & Mag., vol. xxii., 1843, p. 371: communicated by E. F. Teschemacher.

POLYADELPHITE.*

This mineral was observed by Prof. Nuttall, who sent a specimen of it to Dr. Thomson for analysis. Its composition proved to be as follows: silica 36·824, lime 24·724, protoxide of iron 22·948, protoxide of manganese 4·428, alumina 3·356, moisture 0·550.

The atoms of silica and bases are nearly equal, and the mineral appears to be composed, from the above numbers, of five simple silicates, thus expressed by Dr. Thomson: $5CalS+4(\frac{5}{6}\underline{F}+\frac{1}{6}\underline{Mn})S+2MgS+AlS$.

Sp. Gr. 3·76. H. = 3·75.

Color yellow of different shades, wine-yellow and greenish-yellow; the colors are not bright; some specimens bear a close resemblance to blende. The mineral is composed of translucent roundish grains, and of imperfectly foliated masses agglutinated together. Lustre resinous; mass opake; small grains translucent. B B, blackens, and assumes the appearance of magnetic iron ore, but does not fuse; with carbonate of soda it fuses into a green glass, which becomes black and opake in the oxidizing flame; with borax fuses into a dark-brown opake glass; with biphosphate of soda it fuses slowly into a transparent colored glass, leaving a silica skeleton.

It occurs with Franklinite and red oxide of zinc at the Sterling Mine, Sussex County, N. J. It is by no means an abundant mineral. It has not been found in crystals.

SPINEL.

Spinell, W. Spinelle, H. Dodecahedral Corundum, M. Zeilanite, W. Pleonaste. Ceylonite. Candite, *Bournon.* Sapphirus octahedra, D.

Combination of alumina and magnesia, colored red by a minute portion of chromic acid, or blue, by the protoxide of iron.

	Aker.	United States.	Ceylonite.
Alumina	72·25	73·308	68·0
Magnesia	14·63	13·632	12·0
Silica	5·45	5·620	2·0
Protoxide of Iron	4·26	7·420	16·0
	96·59 Berzelius.	99·980 Thomson.	98·0 Descotils.

The silica and protoxide of iron are regarded as accidental, and the essential ingredients, alumina and magnesia, are united, six atoms of the former to one of the latter. Formula: $MgAl^6$.

Sp. Gr. 3·5. H. = 8·0.

Spinel occurs crystallized either in regular octahedrons, occasionally having their edges replaced, or in macles presenting very different forms. It exhibits various shades of red, violet, green, or yellow; more rarely black (*Pleonate*). Its structure is lamellar, though not very distinctly so; but it yields to mechanical division parallel to the faces of the octahedron. Its fracture is commonly flat conchoidal, with a splendent vitreous lustre. It scratches quartz easily, but is not so hard as the oriental ruby, from which it is readily distinguished both by its color and crystallization. It is infusible *per se;* the red varieties become brown and even black and opake as the temperature is increased, but on cooling they appear first green, then almost colorless, and at last resume their red hue. With borax, fuses slowly into a transparent glass with little color; does not fuse but swells up with carbonate of soda, and fuses with difficulty in biphosphate of soda.

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* From πολυς, and αδηλφος, a brother. So called because it consists of five different silicates united.

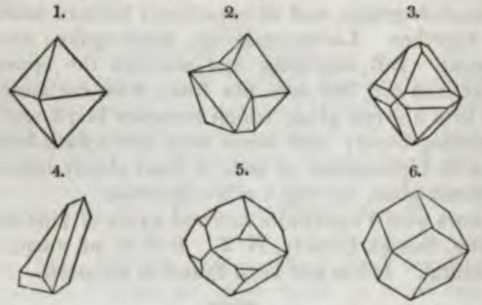
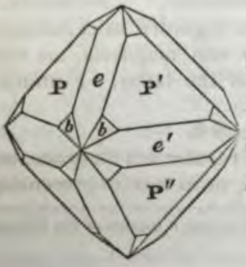
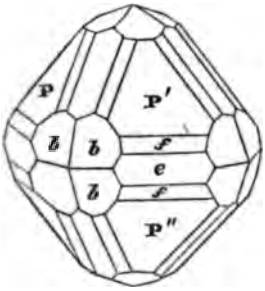


Fig. 1. the primary; the regular octahedron. Fig. 2, a macled crystal, in such a position as shows it to be composed of about equal parts of an octahedron (fig 1), of which one half is half turned round. Fig 3, the octahedron with its edges replaced. Fig. 4, a macle consisting of two equal and similar portions of a crystal resembling fig. 3, being sections, parallel with two opposite primary planes, placed base to base. Fig. 5, the primary octahedron of which the edges are more deeply replaced than on fig. 3, — the triangular planes being portions of the octahedron, and when completely obliterated, resulting in the rhombic dodecahedron, fig. 6.



P on P′ or P′ on P″	109°	28′	16″	H.
P or P′ on e, or P′ or P″ on e'	144	44	8	"
b on b	129	31	16	"
b on P or b on P′	150	20	00	

PLEONASTE.



P on P' or P' on P'' . .	109°	28'	16''	H.
P' or P'' on *e*	144	44	8	H.
P' on *f* or P'' on *f* . . .	157	50		
e on *f* or *f'*	166	36		
b on *b*	144	54	10	H.
b on P' or *b* on P''. . .	150	25		

Spinel is principally found in Ceylon, Siam, and other eastern countries, where it occurs, like most other gems, in isolated and rolled crystals in the channels of rivers. But crystals from Ceylon have been found imbedded in primitive limestone, and in rocks containing adularia and mica. The pale-blue and pearl-grey varieties occur imbedded in calcareous spar at Aker in Sudermannland, Sweden. In the drussy cavities of the rocks ejected by Vesuvius, very perfect and splendent small black crystals have been found with mica and idocrase; also in compact gehlenite at Monzoni in the Fassathal, Tyrol, and in the volcanic rocks of Laach near Andernach on the Rhine.

All the varieties of this species occur in the United States. A splendid blue spinel was discovered several years since in the limestone quarries at Chelmsford, Mass., by Dr. Jackson, and inferior specimens are met with in the same rock in the neighboring towns of Bolton and Littleton. Crystals of the black variety of very large size, from ten to sixteen inches in diameter, and those smaller of various shades of green, brown and red, occur in limestone, at Amity and Warwick, N. Y., with brucite, crichtonite, hornblende, &c. Also at Hamburg, Franklin, Newton, Byram, N. J., of every shade of color from a beautiful bluish-green ceylonite (nearly transparent) to a jet black pleonaste, with rutile, sapphire, brucite, tourmaline, &c. Dr. Fowler, of Franklin, who was one of the first to investigate the minerals of this district, has a pale rose-red octahedron, four inches round at the base, and another of a black color, sixteen inches at the base. The best macles of a red or brownish color, are from Byram, a new locality, discovered by the editor in 1842. They are perfect exhibitions of figs. 2 and 4, and in size from one to two inches. Prof. Nuttall describes crystals from Franklin, in which the solid angles of the octahedron are replaced, thus passing into the cube, which he observes he has "obtained apparently complete, and of a bright green color."—*Robinson's Catalogue*, p. 299.

By lapidaries the scarlet colored is termed ***Spinel Ruby;*** the rose red, ***Balas Ruby;*** the yellow or orange red, the ***Rubicelle;*** and the violet colored, ***Almandine Ruby.*** The variety pleonaste has hitherto been described as a distinct species by Phillips, but the editor in concurrence with the most recent authors, has now united it with common spinel, with which it agrees in all essential characters. Having been found at Candy, Ceylon, it was called *Candite* by Bournon.

The mineral which occurs in the town of Warwick, N. Y., and has been described under the name of PSEUDOLITE, as a variety of spinelle, is now supposed to have originated from the "intrusion of serpentine into the crystals of spinelle, parts of which have been removed, and the cohesion of the whole having become so impaired as to bring about the apparent softness of their crystals, while the particles are really as hard as they prove to be, when subjected to the action of the pestle."—*Prof. Beck.*

SAPHIRINE.

Stromeyer. Levy.

Sp. Gr. 3·42. H. = 7·0 — 8·0.

Alumina 63·11, silica 14·50, magnesia 16.85, lime 0·38, oxide of iron 3·92, oxide of manganese 0·53, water 0·49 — *Stromeyer.*

Occurs disseminated in translucent grains of a pale-blue, or green color. Lustre vitreous. Streak white. Fracture imperfect conchoidal Is not affected B B, either alone or with borax. Not altered by exposure to a red heat.

This mineral was discovered by Giesècké, associated with mica and fibrous brown anthophyllite, at Akudlek in Greenland. It was distinguished from sapphire, which it somewhat resembles, by Stromeyer.

TURNERITE.*

Pictite. Turnerite. *Levy.* (*Ann. of Phil.*, New Series, vol. v., p. 241.)

H. above 4·0.

This rare mineral occurs in small crystals of a yellowish or brownish-yellow color; brilliant externally; and translucent, approaching to transparent. The primary form is, as determined by Levy, an oblique rhombic prism; but the only natural joints that have been observed (they are occasionally visible by transmitted light) are parallel with both diagonals of the prism; one of them is easily obtained with brilliant surfaces. Streak white or greyish. According to Children, it contains alumina, lime, magnesia and a little iron.

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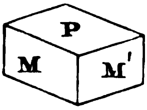
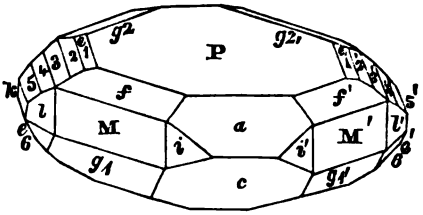
* In honor of C. H. Turner, Esq., the possessor of the rich collection of minerals illustrated in three volumes, by M. Levy.

Primary.





M on M'	96°	10'	L.	M on *e*6 or M' on *e*6' .	144°	51	L.
P on M or M'	99	40	L.	—— *g*1 or — *g*1' . .	140	50	L.
—— *a*	142	29	L.	—— *i* or — *i*' . . .	162	15	L.
—— *e*1 or *e*1'	155	17	L.	—— *l* or — *l*'	161	2	L.
—— *e*2 or *e*2'	139	25		—— *k*	90	00	L.
—— *e*3 or *e*3'	137	22	L.	*a* on *c*	92	55	
—— *e*4 or *e*4'	135	00		—— *f*	149	38	
—— *e*5 or *e*5'	117	48		*c* on *g*1	143	30	
—— *f* or *f*'	133	50		—— *k*	90	10	
—— *g*2 or *g*2'	153	52		*i* on *i*'	131	50	
—— *k*	131	55		*k* on *g*1	126	30	
M or M' on *a*	126	10		—— *e*6	146	10	
———— *c*	118	45		—— *l*	150	55	

Such of the preceding measurements as have the letter L added to them, were taken by Levy.

It has been found only on Mount Sorel in Dauphiné, accompanying quartz, adularia, chrichtonite, and anatase; and has occasionally passed among mineralogists under the name of *Pictite*.

HYDRATE OF MAGNESIA.

Native Hydrate of Magnesia, *Bruce*. Native Magnesia, *Cleaveland*. Magnésia Hydratée, H. Hydromagnesite, *Kobell*. Margaritus magnesicus, D.

Combination of magnesia and water.

	Hoboken.		Unst.	Unst.
Magnesia	70·0	69 75	66·67	67·98
Water	30·0	30·25	30·39	30·96
	100·0 Bruce.	100·00 Fyfe.	97·06 Stromeyer.	98·94 Thomson.

Sp. Gr. 2·55. H. = 1·0 — 1·5.

Portions of manganese and iron were also observed by Stromeyer and Thomson, but these being obviously accidental, the mineral is a simple hydrate.

It occurs in plates, which have a lamellar structure, and occasionally present indications of a six-sided prism, which is assumed as the primary form, and parallel to the base of which it readily separates into plates. It is white, occasionally with a tinge of green; semi-transparent, with a somewhat pearly lustre, but becomes opake by exposure; is rather elastic, adheres slightly to the tongue, and is so soft as to yield to the nail. It dissolves entirely in muriatic, nitric, and dilute sulphuric acids, without effervescence. B B it gives off water, becomes opake and friable, but does not fuse.

This mineral was brought into notice by the late Dr. Bruce, of New York, and was discovered by him in the serpentine cliffs of Hoboken, opposite New York city. It has also been brought from Unst, Swinaness, in one of the Shetland Islands, where it is contained in the same rock;* and Von Kobell has lately discovered it in specimens of serpentine from Negropont, in Greece. He has named it hydromagnesite.

CHRYSOLITE.†

Krysolith, W. Peridot, H. Prismatic Chrysolite, M. and J. Anhydrous Silicate of Magnesia, *Thomson*. Chrysolithus rectangulus. D.

Combination of magnesia, silica, and protoxide of iron.

	Chrysolite. Crystal.	*Olivine.* Unkel.	*Olivine.* Somma.	*Meteoric.* Olivine.	*Meteoric.* Olivine.
Magnesia	50·13	50·49	44·24	47·35	47·35
Silica	39·73	40·09	40·08	40·86	40·83
Protoxide of iron	9·09	8·17	15·26	11·72	11·53
Prot. of manganese	0·00	0·00	00·00	0·43	00·00
Oxide of tin	0·00	0·00	00·00	0·17	00·00
	99·95 Strom.	98·75 Strom.	99·58 Walm.	100·53 Berz ‡	99·71 Walm.

Stromeyer noticed also a minute portion of nickel, Klaproth a little lime, and Walmstadt some manganese and alumina. These, however, are very variable, and must be regarded as accidental; but Walmstadt has given the results of six analyses of this mineral from different localities, in which he finds a mean of about ten per cent. protoxide of iron. This by some is viewed as essential, and it is included in the formula given by Beudant; but if we regard it as accidental, the result is 1 atom silica, 1 atom magnesia; or a simple anhydrous silicate of magnesia. Formula, MgS.

Sp. Gr. 3·3 — 3·5. H. = 6·5 — 7·0.

Chrysolite occurs in angular or somewhat rounded crystalline masses, and in prismatic crystals variously terminated. Their primary form is a right rectangular prism, which may be obtained by cleavages parallel to all its planes, yielding the measurement of 90° every way by the reflective goniometer; the cross fracture is conchoidal with a vitreous lustre; color bright yellow, sometimes tinged with green or brown; transparent or translucent; and possesses double refraction. *Per se*, it is infusible B B, but becomes darker; with borax it forms a transparent green glass.

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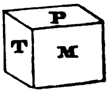
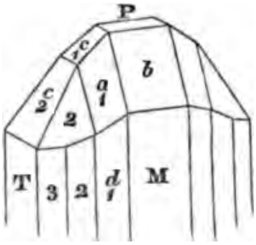
* Prof. Necker, of Geneva, has lately described several of the hexagonal crystals from Unst, which have their three alternate terminal edges truncated by planes oblique to the axes, thus seeming to indicate a rhomboid as the primary form of this mineral. (Jameson's Edin. Jour. xxix., 75.) [Am. Ed.]

† Chrysolite, signifying a valuable stone, or gem.

‡ The olivine contained in the great mass of Siberian meteorite, now removed to St. Petersburg, the crystals of which G. Rose has measured, and found to agree with those of common olivine. (Poggendorf's Annalen., vol. iv., p. 195.)—[Am. Ed.]

Primary.



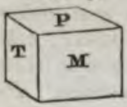


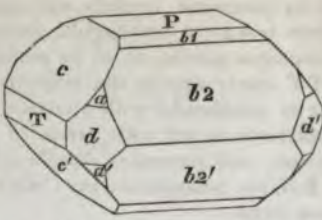
P on M T or M on T	90°	00′	
M on *d* 1	154	52	
—— *d* 3	119	13	H.
—— *a* 1	137	00	
—— *a* 2	128	50	
—— *b*	141	50	H
T on *c* 1	119	29	
—— *c* 2	139	20	
P on *b*	128	20	H.
b on *a* 1	160	2	
a 1 on *a* 2	163	55	
d 1 on *d* 2	162	17	H.

The best specimens of chrysolite are brought from Constantinople and the Levant, but under what circumstances they are found, we have not been informed. It is found also occasionally in pale-green transparent crystals, among sand, at Expaillie in Auvergne; at Vesuvius; and in the Isle of Bourbon.

Olivine. Olivin, W. Peridot granuliforme, H. Olivine is a variety of chrysolite, differing slightly in respect of analysis, the general form of its crystals, and also in cleavage. It is chiefly found in olive-colored semi-transparent masses, which, from their being in a state of decomposition, have externally an iridescent, and somewhat metallic lustre; fracture imperfect conchoidal; not so hard as chrysolite. It occurs in crystals whose primary form may be considered a right rectangular prism, but they yield to cleavage with regularity only parallel to the terminal plane P of the following figure. B B alone it becomes somewhat brown without fusing; with borax it melts slowly into a diaphanous glass, colored by iron.

Primary.





P on T or *d*	90°	00′
—— *e* . .	140	00
—— *b* 1 .	132	52
—— *b* 2 .	115	00
T on *d* . .	130	00
e on *e*′ . .	80	00
b 2 on *b* 2′	130	00
d on *d*′ . .	100	00
—— *a* . .	160	00

The above figure represents a crystal in Mr. Majendie's collection, from the current of lava which flowed into the sea at Torre del Greco.

Olivine is met with abundantly in certain lavas, basalts, and other volcanic rocks; crystals, several inches in diameter, are found in compact greenstone at Unkle, near Bonn on the Rhine; large spheroidal masses in trap-tuff at Kapferstein in Stiria; at Habichtswald in Hessia; and at Vesuvius. These, however, are generally granular, disintegrating and falling to pieces on the pressure of the fingers. In small quantity it occurs in many of the basalts of Great Britain and America. Rare specimens of transparent olivine, accompanied by pyroxene, have recently been brought to the United States from the great volcano Kirauea, in the island of Owhyhee, by members of the exploring expedition.

Meteoric Olivine. The semi-transparent olivine inclosed in the mass of meteoric iron found in Siberia by Pallas, is only peculiar for its straw-yellow color. See its analysis, page 140.

The small, uncrystalline, wax- or honey-yellow masses, of which the one is with difficulty, the other more easily fusible B B, observed by Saussure in the basalt of Limbourg, and which he denominated *Limbelite* and *Chusite*, (*Péridot altéré*, *Beudant*,) appear to be decomposed varieties of this species.

HYALOSIDERITE.*

This mineral was observed by Dr. Walchner in an amygdaloid in the Kaiserstuhl, near Sasbach in Brisgau. He published a description and analysis of it in 1823.† It is composed of,

Silica	31·634
Protoxide of iron	29·711
Magnesia	32·403
Alumina	2·211
Protoxide of manganese	0·480
Potash	2·788
Chromium, a trace,	0·000
	99·277

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* From υαλος, glass, and σιδηρος, iron.

† Schweigger's Jahrbuch, ix. 65.

Formula as given by Dr. Thomson, $2MgS+\underline{F}^2S$.

Sp. Gr. 2·875. H. = 5·5.

Color yellowish or reddish-brown; streak cinnamon-brown; fracture small conchoidal. It is usually crystallized. The primary form is an octahedron with a rectangular base. The summits are commonly replaced by planes parallel to the base, and cutting the pyramids so deep, that the crystals have the appearance of thin plates with bevelled edges. P on P′ 99° 22′, M on M′ 77° 50′. Internal lustre vitreous; of the surfaces metallic; translucent on the edges. B B it becomes black and then melts into a black bead, which is attracted by the magnet. With borax it fuses easily into a clear glass, greenish-yellow while hot; but nearly colorless when cold. With biphosphate of soda it forms a greenish glass leaving a silica skeleton.

LIGURITE.*

Viviani.—Mem. dell' Accad. delle Scienze, lettere ed arti di Genova, iii. Ligurit, *Leonhard.*

Consists according to Viviani, of silica 57·45, alumina 7·36, lime 25·30, magnesia 2·56, oxide of iron 3·00, oxide of manganese 0·50.

This mineral is described as occurring in oblique rhombic prisms of 140° and 40°, sometimes modified, of an apple-green color, and occasionally speckled externally. Its fragments are uneven and transparent, with a vitreous lustre. Streak greyish white. Specific gravity 3·49. It does not become electric either by heat or friction, and exhibits no phosphorescence when placed on live coal.

It occurs in a sort of talcose rock, on the banks of the Stara in the Apennines. According to Leonhard, it is considered as a gem superior to chrysolite in color, hardness and transparency. It is classed by Dana as a variety of chrysolite.

FORSTERITE.

Levy, Ann. Phil., 2nd. series, vii., 61. Topazius Vesuvianus, D.

H. about 7·0.

Contains magnesia and silica, according to Children.

Primary form a right rhombic prism, whose faces are inclined to one another at angles of 128° 54′ and 51° 6′.

Occurs in small, colorless and brilliant translucent crystals. Cleavage perfect, and easily obtained parallel to *o*.

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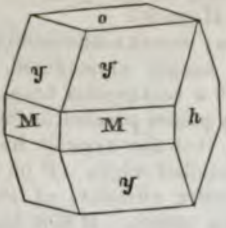
* Ligurite, after Liguria, the country in which it is found.



M on M	128°	54′
y on *y* over M	107	46
y on *y* adjacent	139	14

Is associated with pleonaste and olive-green pyroxene at Vesuvius. Its angles pretty nearly correspond with those of chrysoberyl; but its cleavage perpendicular to the axis, which is extremely distinct in Forsterite, has not been observed in that mineral.

CONDRODITE. BRUCITE.*

Condrodite, *Berzelius.* Brucite, *Gibbs.* Hemi-prismatic Chrysolite, M. Macluerite, *Seybert.* *Langstaffite.* Carbunculus obliquus, D.

	Finland.	New Jersey.	New Jersey.
Silica	38·00	32·666	36·00
Magnesia	54·00	54·000	54·64
Peroxide of iron	5·10	2·333	3·97
Potash	0·86	2·108	0·00
Fluoric acid	0·00	4·086	3·75
Water	0·00	0·000	1·62
	97·96 D'Ohsson.	96·193 Seybert.†	99·98 Thomson.‡

	New Jersey.	Grey-colored, Pargas.	Yellow-colored, Pargas.
Silica	33·06	33·10	33·19
Magnesia	53·46	56·61	54·50
Peroxide of iron	3·65	2·35	6·75
Fluoric acid	7·60	8·69	9·69
	99·77 Rammelsberg.§	100·75 Rammelsberg.	104·13 Rammelsberg.

Formula given by Seybert, with whose results all the later analyses nearly accord: $Mg^2\dot{F}l+3MgS$. The iron and potash are thus regarded as unessential ingredients; and it is to be observed that the latter was not found in either of the specimens examined by Rammelsberg. It will be noticed also that the analyses by Rammelsberg give a larger per centage of fluoric acid. He has hence drawn a different formula, according to which the mineral ought to consist of silica 37·28, magnesia and oxide of iron 58·40, (supposing that the latter replaces the magnesia,) and 7·55 of fluoric acid. He thus states the chemical formula: $\mathrm{MgF}+2\dot{\mathrm{M}}\mathrm{g}^3\dddot{\mathrm{S}}\mathrm{i}$, which is the same as that given before by Von Kobell.

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* Condrodite, from its occurring in grains. Brucite, in honor of the late Prof. Bruce, of New York. Macluerite, in honor of the late Wm. Maclure.

† Amer. Jour. of Sci., vol. v., p. 336.

‡ Outlines, &c., vol. i. p. 184.

§ Poggendorf's Annalen., liii., p. 103, 1842, or Berzelius's Rapport Annuel, 1842, p. 120.

Sp. Gr. 3·15 to 3·22. H. = 6·5.

This mineral occurs massive, and in small grains, having occasional, but not very decided appearances of regular external form, and crossed by nearly parallel refts, of which the surfaces have a somewhat pearly lustre. No decided marks of regular internal structure are discernible in them; but the massive of Pargas is divisible into apparently rhombic prisms; and that of New Jersey is described as occurring in short oblique rhombic prisms differently modified, and too imperfect to admit of measurement; rarely the plane oblique faces of the prism are visible, and this cleavage is obtained with great difficulty; but parallel with M M′ cleavage faces are sometimes produced in breaking the masses, which give an angle of about 112°. The color wine, or wax-yellow, brownish-yellow sometimes of a deep orange; it is translucent, lustre glassy, or almost resinous; yields to the knife with difficulty; and by friction acquires a resinous electricity.[*]

B B, it is infusible, but loses its color; with borax it fuses slowly but completely into a transparent glass, tinged by iron. The brown varieties act slightly on the magnet; it dissolves in nitric acid. The presence of fluoric acid is readily shown by its action upon glass, when the mineral is decomposed by sulphuric acid.

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[*] There is no mineral in the whole range of the science, that offers a more interesting history than the present species, considered in reference to its chemical nature; and it is to American mineralogists and chemists that we owe our most important knowledge concerning it. Dr. Langstaff of New York, was, unquestionably, the first to detect the presence of fluoric acid in the New Jersey mineral, (a) while Mr. Seybert of Philadelphia has the honor of having first discovered it in the Pargas variety, (b) in which it seems to have been overlooked both by Berzelius and D'Ohsson who had examined it. But Dr. Langstaff's results had not become generally known, when, in 1822, and previous to his examination of the Pargas mineral, Seybert (c) announced his discovery of fluoric acid in a specimen from New Jersey, without the least knowledge, as he declares, of what had been done by Langstaff. He had inferred from their characters that Brucite and Condrocite were different minerals, though Berzelius had viewed them as identical; but the result of his examination was finally to show the existence of fluoric acid as an essential constituent of both, and to establish their identity. Soon after, Dr. Thomson made known his analysis of the New Jersey mineral, and fully confirmed Seybert's. Thus it appears that Seybert, equally with Langstaff, was the discoverer of fluoric acid in condrodite. It should be added, that several years before Seybert made known his discovery, Dr. Torrey of New York, read before the Lyceum of Natural History, his analysis of brucite, in which he had found a large portion of silica, and proved the mineral to be a fluo-silicate, and not simply a fluate of magnesia, as it had been regarded by many of our mineralogists, and under which name it was mentioned in the first edition of Cleaveland's mineralogy. At this time he was not aware of Langstaff's prior experiments. The analysis by Berzelius I have not been able to find. Langstaff obtained, silica 32, magnesia 51, oxide of iron 6, fluoric acid 9, water 1. It was at first supposed to be sphene, by Dr. Bruce, the original discoverer of the mineral in the United States. [Am. Ed.]

(a) The date of his discovery is 1811. Amer. Jour. of Sci. vi., 171.

(b) Amer. Jour. of Sci., v., 336.

(c) Ib., v., 336.

The only European localities of this species are the district of Pargas, Finland, (discovered by Berzelius,) and Oken in Sweden, where it is imbedded in limestone with spinelle and pargasite. In the United States, in Sussex County, N. J., and Orange County, N. Y., there are several localities which have been long known to mineralogists. They occur in a beautiful white crystalline limestone, (*altered blue limestone of Prof. Rogers,*) the repository of the various other interesting minerals of those districts. Some of the largest masses have been found at Byram, but the finest colored specimens have been brought from Sparta, of the former state. Quite recently a locality of brucite has been discovered by Prof. Rogers in a bed of white limestone, near Chad's Ford, on the Brandywine, Penn.

HUMITE.[*]

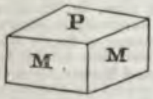
Bournon, Cat. p. 52. Carbunculus acrotomus, D.

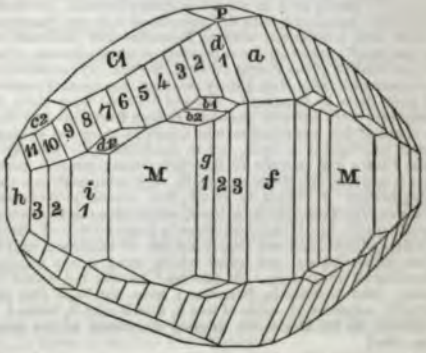
Composition according to Bowen[†] very similar to brucite, containing fluoric acid.

Sp. Gr. 3·2. H. = 6·6.

It occurs in very small crystals, which are of a yellowish or deep reddish-brown color; and transparent or translucent; with a shining lustre. The crystals are modified in an extraordinary degree; their primary form may be considered as being a right rhombic prism of 60° and 120°, but they yield to cleavage parallel only to its shorter diagonal (*i. e.* to the plane *h* of the following figure). B B it becomes opake, but does not fuse; and with borax affords a clear glass.

Primary.





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[*] Humite, in honor of Sir Abraham Hume.

[†] Amer. Jour. of Science, vol. v., p. 244. But no complete analysis of the mineral has been published.

M on M	120° 00′	*h* on *d* 4	119° 24′	*h* on *i* 2	140° 56′
P on M or M	90 00	—— *d* 5	121 45	—— *i* 3	143 20
—— *f* or *h*	90 00	—— *d* 6	125 30	*c* 1 on *d* 1	155 2
M on *h*	120 00	—— *d* 7	129 46	—— *d* 5	159 10
—— *d*	118 12	—— *d* 8	121 20	—— *d* 7	159 30
—— M or *f*	150 00	—— *d* 9	124 2	*d* 1 on *g* 3	116 25
P on *c* 1	144 1	—— *d* 10	136 16	*d* 12 on *d* 8	163 22
—— *c* 2	153 45	—— *d* 11	157 20	—— *g* 3	131 15
h on *a*	90 00	—— *g* 3	100 40	*b* 2 on *g* 3	143 15
—— *d* 1	101 50	—— *g* 2	103 40	*b* 1 on M	137 00
—— *d* 2	103 42	—— *g* 1	115 15	*f* on *a*	115 10
—— *d* 3	112 45	—— *i* 1	133 36		

It is found on Monte Somma, with brownish mica, pleonaste, and other volcanic minerals; the crystals, though minute, being extremely distinct. It is described by Monticelli and Covelli of Naples, in their *Prodomo della Mineralogia Vesuviana*, and is regarded by them as identical with condrodite.

SERPENTINE.*

Ophite, L. Hydrous Sesquisilicate of Magnesia, *Thomson*. Ophitis communis, D. Ophitis, *Vetruvius*. Talcum serpentinum, *Lin.*, *Wern.*

Has been divided into noble and common serpentine, a distinction which it is not very easy to draw. The term noble applies to such varieties as have a uniform green color, and are translucent, and fit for cutting; while common serpentine has a more earthy texture, is less impalpable, and often contains admixtures of foreign matter.

		Hoboken.	Fahlun.
Silica	42·50	41·67	41·95
Magnesia	38·68	41·25	40·64
Alumina	1·00	0·00	0·37
Lime	0·25	0·00	0·00
Oxide of iron	1·50	1·64	2·12
Oxide of manganese and chrome	0·37	0·00	0·00
Water	15·20	0·00	11·68
Carbonic acid and bitumen	0·00	13·80	3·42
	100·00 John.	98·36 Vanuxem.	100·48 Lychnell.

	Pseudomorphous, Snarum.	*Precious*, Newburyport.
Silica	42·97	42·00
Magnesia	41·66	40·00
Alumina	0·87	0·00
Oxide of iron	2·48	1·00
Water	12·02	14·38
Carbonic acid and bitumen		0·00
Loss	0·00	2·62
	100·00 Hartwell.	100·00 Vanuxem.

The mean of ten careful analyses of pure serpentine as stated by Thomson, (nine of them by Lychnell,) shows the constitution of this mineral to be 1½ atom silica, 1 atom magnesia, 1 atom water, or by the formula, $MgS^{1\frac{1}{2}}+Aq$.

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* Serpentine and Ophite, from the Latin and Greek, in allusion to the spotted or variegated appearance, — like the skin of a snake, — which it frequently presents.

Sp. Gr. 2·5 to 2·56. H. = 3·0.

Color commonly dark green, passing into yellow and grey. Translucent or opake, with a slightly resinous lustre. Fracture conchoidal or splintery; is occasionally somewhat unctuous to the touch, and yields easily to the knife; but it neither adheres to the tongue nor is scratched by the nail. It loses its water, and hardens on exposure to heat; B B, the thin edges may be fused into an enamel; with borax it melts slowly into a greenish transparent glass, which becomes almost white on cooling.

Dark-green opake crystals of this substance have been met with in the Fassa valley, Tyrol; their form, however, is generally so indistinct that a few only of the faces can be traced, and by many they are considered as pseudomorphs; perhaps, as Quernstedt has lately attempted to show, pseudo-crystals of chrysolite. But more regular and undoubted forms, indicating a right rectangular prism for the primary have been met with in the Weisstein of Penig in Saxony, and in a blackish-green variety, the locality of which is not known. At Snarum in Norway, it is found in greenish-grey masses, which contain large and perfect pseudomorphous crystals. Noble serpentine occurs at Fahlun and Gulsjö in Sweden, in the Isle of Man, the vicinity of Portsoy in Aberdeenshire, in Corsica, Silesia, Saxony, &c.

There are several important localities of serpentine in the United States. The precious variety, of a light-green color, is found at Phillipstown, N. Y., frequently including seams of asbestus. Also at Newburyport, Mass.; New Fane, Vt.; at Hoboken, N. J.; at Amity and Warwick, N. Y., where crystals of a blackish-green color, in the form of oblique four-sided prisms, from twelve to sixteen inches in circumference were first observed by Dr. Fowler, associated with brucite and black spinelle, in crystalline limestone. It is probable that these are also pseudomorphous.

Common serpentine is frequently traversed by veins of asbestus, and occurs in masses and beds in primitive rocks in the Shetland Isles, at the Lizard in Cornwall, in Piedmont, Saltzburg and elsewhere on the continent. The following are to be regarded as varieties of serpentine.

1. **Deweylite of Emmons.** This variety is found in seams and irregular veins at Middlefield, Mass. It contains magnesia 40·00, silica 40·00, water 20. — *Shepard.* Specific gravity 2·3, hardness 3; color white, yellowish and greenish-white. Translucent, streak white, lustre vitreous, inclining

to resinous. Easily frangible, especially if immersed in water. It exhibits small mamillary concretions. Fracture even and imperfectly conchoidal.*

2. METAXITE OF BREITHAUPT. This is also supposed to be a variety of serpentine. Composition, silica 45·04, Magnesia 34·00, peroxide of iron 5·28, water 15·40. Specific gravity 2·421; hardness 3·5. Color greenish-white; lustre silky. Texture fibrous. Rather sectile. B B, fuses without communicating any color to the flame. Ignited with nitrate of cobalt, it assumes a lilac color, showing the presence of magnesia.—*Thomson's Outlines of Mineralogy*, i., 171.

3. PICROLITE OF HAUSMANN. This must also be classed as a variety of the present species. Composed according to Almroth, of magnesia 38·80, silica 40·04, water 9.08, protoxide of iron 8·28, carbonic acid 4·70. It is massive or fibrous, with a radiated structure. Color leek-green, passing into yellow. Translucent on the edges. Streak somewhat shining. It colors glass of borax-green; but the color disappears on cooling. It occurs in irregular veins at the Taberg of Smaland in Sweden, traversing beds of magnetic iron ore, and associated with calc spar and serpentine.

4. KEROLITE. *Leonhard and Briethaupt.* Contains silica 37.95, alumina 12·18, magnesia 16·02, water 31·00.—*Pfaff.* It is found in kidney-shaped masses, which have a lamellar or compact structure, and a white, yellow, or green color. Lustre vitreous or resinous; transparent or translucent; fracture conchoidal; feels greasy, but does not adhere to the tongue.

It occurs at Frankenstein in Silesia, and at Zöblitz in Saxony, in both localities associated with serpentine.

5. HYDROPHITE.† M. Scanberg has analyzed a species of green serpentine found at Taberg in Smoland, and in which Mr. Laguhjehm had discovered the presence of vanadium. This mineral is amorphous, soft, has an irregular fracture, is of a mountain-green color, and of the specific gravity 2·65. B B it gives out water, but does not melt. It contains 36·195 silica, 22·729 oxide of iron, 1·66 oxide of manganese, 21·082 magnesia, 0·115 vanadic acid, 16·080 water.

6. Another mineral analogous to serpentine has also been described by M. Svanberg under the name Piérophylle. It is amorphous, of a flaky texture and crystalline appearance; but the faces of the crystals being the faces of the laminæ. It is dark greenish-grey; hardness between calcareous spar and

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* Emmons's Manual of Mineralogy and Geology, p. 235.

† Berzelius's Rapport Annuel for 1840, p. 119.

mica. Specific gravity 2·75. B B it gives off water, and does not melt. Composed of silica 49·80, magnesia 30·11, oxide of iron 6·86, lime 0·78, alumina 1·11, water 9·83. It was found at Sala.

SOAPSTONE.

Speckstein, W. Talc Steatite, H.

The soapstone of Cornwall consists of 44 silica, 9·87 alumina, 24·14 magnesia, and 21·22 water.—*Thomson.* It is found massive, and nearly white or of a grey color, sometimes with a tinge of yellow, and mottled with green or purple; when first raised it may be kneaded like dough, but by exposure loses a part of its moisture, and is then translucent on the edges, yielding to the nail, and possessing an unctuous feel: hence its name.

It occurs in a vein of serpentine at the Lizard Point at Cornwall, where it sometimes presents the appearance of passing into asbestus. It is used in the manufacture of porcelain at Swansea in Wales, and is also found near the Cheesewring, at St. Cleer in Cornwall.

It is commonly classed with steatite, but is much softer. In the composition of steatite no alumina has been detected, and it is infusible, whereas soapstone fuses into a white enamel. It sometimes includes veins of asbestus.

1. Steatite.* Speckstein, W. Talc Steatite, H.

			Steatite, Cornwall.
Silica	59·5	50·60	42·88
Magnesia	30·5	28·83	24·14
Oxide of iron	2·5	2·59	9·87
Water	5·5	15·00	21·22
	98·0 Klaproth.	97·12 Dewey.	98·11 Thomson.

Sp. Gr. 2·65.

Steatite presents various shades of white, grey, yellow, green, and red, and is met with only massive; the distinctly pronounced crystals, which occur imbedded in a massive variety of the same mineral at Gopfersgrünn in Bayreuth, being pseudomorphous of the common variety of quartz, or occasionally of calcareous and pearl spars. It has generally an unctuous feel; yields to the nail, but does not adhere to the tongue; fracture splintery, sometimes slaty; somewhat translucent on the edges; hardens B B, and becomes black, but is infusible.

Steatite is found in considerable masses, or in beds or veins, in some primitive mountains. It is most common in serpentine. At Freyberg in Saxony it occurs in tin veins, accompanied by or mingled with mica, asbestus, quartz, and occasionally native silver, &c. It abounds in the principality of Bayreuth, and is also found in Bohemia, Norway, Sweden, and France; in the Isle of Anglesey; at Portsoy, in Aberdeenshire, in serpentine; in the Isle of Skye, and others of the Hebrides, in wacké; and in Fifeshire, of a sky-blue color, with limestone.

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* From a Greek word, signifying soap, in allusion to its greasy feel.

In the United States, New-England affords many very extensive beds of this useful mineral: as Somers and Bristol, Ct., Oxford and Grafton, N. H., Fitchburg and Millbury, Mass. Smithfield, R. I., has probably supplied more for the arts and manufactures than any other locality. It occurs also in New-Jersey and Pennsylvania; as described in Prof. Rogers's Reports.

The white varieties, or those which become so by calcination, are employed in the manufacture of porcelain: others are used for fulling. The Arabs, according to Shaw, use steatite in their baths instead of soap, to soften the skin; and Humboldt states that the Otomaques, a savage race inhabiting the banks of the Oronoko, are almost entirely supported during three months of the year by eating a species of steatite, which they first slightly bake, and then moisten with water.

2. Potstone. Topfstein, W. Talc ollaire, H. Pierre ollaire, Br. Serpentine ollaire, Bt. Is a coarse, indistinctly granular variety of indurated talc, having a greenish-grey or leek-green color, with a glistening or pearly lustre. Contains silica 49·01, magnesia 30·20, alumina 6·08, protoxide of iron 11·40, water 4·2.—Variety from Sweden by *Thomson*.

Potstone is plentifully found at Chiavenna, in the Valteline; at Como, in Lombardy; and, generally speaking, in serpentine countries; in Norway, Sweden, Finland, and Greenland. Its united properties of infusibility, softness, and tenacity, admit of its being readily turned on the lathe; from time immemorial it has been formed into vessels[*] in the Valais and Grisons; and Pliny describes it as being used in like manner in his time.

NEPHRITE.[†]

Uncleavable Nephrite Spar, *Haidinger*. Nephrite, Common Jade, Axe Stone, J. Jade Nephritique, H. Nephrus amorphus, D.

	Iona.	Smithfield, R. I.
Silica	44·85	44·68
Magnesia	36·05	34·63
Alumina	1·30	0·56
Oxide of iron	3·60	1·74
Lime	0·00	4·25
Water	13·55	13·41
	99·35 Thomson.	99·27 Bowen.

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[*] Whence the name of Potstone.

[†] From νεφρος, a kidney, the diseases of which it was supposed to cure.

Regarding the iron and lime as accidental, this mineral is a hydrous sesquisilicate of magnesia, or has the same formula as serpentine: $MgS^{1\frac{1}{2}}+Aq$. Some specimens give a trace of oxide of chrome.

Sp. 2·9—3·0. H.=7·0.

Nephrite occurs in masses of a leek-green color, passing into grey and greenish-white; is translucent on the edges; extremely tough; fracture coarse-splintery. *Per se*, B B, it is infusible, but becomes white; and with borax forms a transparent glass.

It occurs in the Hartz, in Corsica, in China, and in Egypt; also in New Zealand, and other islands in the Pacific, where it is made into hatchets and implements of war.

In the United States a beautiful sky-blue variety is found in veins and nodules in primitive limestone in Smithfield, R. I.; a green or greenish-grey variety at Easton, Penn.; and recently Dr. Jackson has discovered it in New Hampshire.

In chemical composition nephrite agrees with serpentine, both being hydrosilicates of magnesia: but as its hardness is more than *twice* that of serpentine, there seems to be a radical difficulty in the way of uniting it with that species. Dr. Thomson, however, thinks they should constitute but one species; and it is remarkable that he puts down the hardness of nephrite at only 3·5.

NEMALITE.

Nuttall. (*Amer. Jour. of Sci.*, vol. IV. p. 19.) Silicious Hydrate of Magnesia, *Thomson.*
Nematus gracilis, D.

Contains	Magnesia	51·72
	Silica	12·57
	Peroxide of iron	5·87
	Water	29·67
		99·83 Thomson.

Formula (iron being accidental): $MgS+2MgAq^2$.

Sp. Gr. 2·35. Scratched by the nail.

Composed of elastic fibres, easily separable, and bearing a striking resemblance to the fibres of amianthus. Color white, with a slight shade of yellow; lustre highly silky; opake; becomes brown on exposure to red heat, and gives off water, but does not melt; is soluble without effervescence, in sulphuric acid, and converted in well-characterized Epsom salts. When rubbed with a piece of iron it phosphoresces with a yellowish light.

This mineral was discovered by Mr. Nuttall, in small veins in serpentine, at Hoboken, N. J., and named in reference to its fibrous structure. It now occurs but sparingly.

MARMOLITE.*

Marmolite, ***Nuttall.*** **Magnesie Hydratée Silicieuse,** ***Levy.*** **Var. Ophitis communis, D.**

Magnesia	46·0	41·25	41·720
Silica	36·0	41·67	41·256
Water	15·0	13·80	17·680
Lime	2·0	0·00	0·000
Oxide of iron	0·5	1·64	0·400
Bitumen and carbonic acid	0·0	1·37	Alumina 1·000
	99·5 Nuttall.	99·73 Lychnell.	102·056 Steel.

Sp. Gr. 2·41 — 2·47. Scratched by the knife.

This mineral occurs in grey and green translucent or opake masses, which have a columnar or foliated texture. Lustre pearly. Cleavage in two directions, parallel to the sides of an oblique four-sided prism; one of them obtained with facility. It decrepitates and hardens B B, separating into feathery-like masses, but does not fuse; and in the matrass yields water. With nitric acid it forms a gelatinous paste.

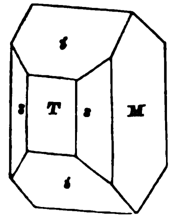
Marmolite occurs associated with hydrate of magnesia in serpentine veins at Hoboken, in New-Jersey; and in the Bare Hills, near Baltimore, United States.†

PICROSMINE.‡

Picrosmine, ***Haidinger.*** **Pikrosmin, L. Dihydrous Bisilicate of Magnesia,** ***Thomson.*** **Nematus rectungulus, D.**

Consists, according to Magnus, of magnesia 33·34, silica 54·88, protoxide of manganese 0·42, protoxide of iron 1·39, water 7·30. According to the analysis, it is a dihidrous bisilicate of magnesia.

Sp. Gr. 2·58 — 2·66. H. = 2·5 — 3·0.



i on i contiguous . . 117° 49′

s on s over T . . . 126° 52′

Primary form a rectangular four-sided prism. Principal cleavage parallel to M. Color greenish-white, sometimes dark-green; nearly opake. Lustre pearly on M; inclining to vitreous on the other faces. Streak white and dull; very sectile. Fracture splintery. Composition granular; strongly coherent. Translucent on the edges. B B, it does not melt, but gives out water, becomes first black, then white and opake, and acquires a hardness equal to 5·0. It is soluble in salt of phosphorus, with the exception of a silica skeleton; and when heated with a solution of cobalt it assumes a pale-red color, even when fused.

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* From μαρμαιρω, to shine, in allusion to its pearly and somewhat metallic lustre.

† The claim of this mineral to the character of a distinct species is very doubtful. Shepard classes it with kerolite, while Dana and Thomson make it a variety of serpentine, with which it most nearly agrees in chemical composition. Vanuxem long ago drew up a comparison of the two minerals, and gave it as his opinion that they formed but one species. (Jour. Acad. Nat. Sci., Philad., vol. 111, p. 129.) [Am. Ed.]

‡ From πικρὸς, bitter, and ὀσμὴ, odor, in allusion to the bitter and argillaceous odor it exhales when moistened.

The only known locality of picrosmine is the iron mine of Engelsburg, near Presnitz in Bohemia, where it is associated with magnetic iron ore. In external appearance it resembles asbestus, but was distinguished and named by Haidinger. (*Translation of Mohs*, vol. iii., p. 137.)

APPENDIX TO PICROSMINE. *Boltonite.* The mineral to which the above name was given by Prof. Nuttall, bears considerable resemblance to picrosmine, and its analysis by Dr. Thomson seems clearly to refer it to that species. It is composed, according to his analysis, of

Silica	56·64
Magnesia	36·52
Alumina	6·07
Protoxide of iron	2·46
	101·69*

Regarding the alumina and iron as accidental, the atoms of magnesia are 14·6, while those of silica are 28·32; showing evidently that the mineral is a bisilicate, and differs only from picrosmine in containing no water. So its formula is simply MgS^2.

Sp. Gr. 2·976. H. = 3·5.

Color white, with a slight shade of green; also bluish-grey and yellowish-grey. Occurs massive, and in irregularly-aggregated prismatic crystals, the cleavages of which afford indications of a doubly oblique prism for the primary form. Streak white; fracture uneven; lustre vitreous; transparent to translucent; B B, becomes white and transparent, but is infusible; with borax yields a transparent glass.

It was first observed disseminated through the white limestone of Bolton, Boxborough, and Littleton, Mass.; and Dr. Horton has subsequently added two or three other localities in New-York, where it is also contained in a similar white limestone. At Bolton it is associated with petalite, and, at the New-York localities, with spinel. Shepard mentioned another locality at Ridgefield, Ct.

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* Outlines of Mineralogy, &c., vol. i., p. 173.

OSMELITE.—*Breithaupt.*

Sp. Gr. 2·79—2·83. H. = 4·0—5·0.

Massive; in thin prismatic concretions, scopiformly or stellularly arranged. Color greyish-white inclining to smoke-grey. Translucent. Lustre not great, between pearly and vitreous. Feels greasy, and when breathed upon emits an argillaceous odor; hence its name, from ὀσμὴ, *smell.* Cleavage in one direction. In the mouth it feels about to dissolve, although no change takes place.

Occurs super-imposed on calcareous spar, mixed with datholite, in trachyte at Niederkirchen, near Wolfstein, on the Rhine.

TALC. CHLORITE.

Prismatic Talc Mica, M. Chlorite, W. Talc, H. Nacrite. Venetian Talc. Margaritus saponaceus, D.

Sp. Gr. 2·7—2·8. H. = 1·0—1·5.

Crystallized chlorite occurs in flat six-sided prisms, derived from the replacement of the acute lateral edges of a right rhombic prism, which is the primary form. Color various shades of green,* passing from dark-green into apple-green and greenish-grey; also pure white and yellowish. Semi-transparent, translucent, presenting different colors in different directions. Lustre pearly on the terminal planes, parallel to which the cleavage is highly perfect. Yields to the nail, and, when in powder, is unctuous to the touch. Streak corresponding to the color, generally white or green. Thin laminæ are easily flexible, but not elastic: a character which serves to distinguish this mineral from mica, which is very elastic. Five specimens of this species, the first three scaly talc, the fourth and fifth the green foliated variety, have yielded the following results:

	Common Chlorite.			Green Talc or Venetian Talc.	
Silica	26·0	26·8	27·62	62·0	62·58
Magnesia	8·0	14·3	10·96	27·0	30·52
Oxide of iron	43·0	23·5	27·54	3·5	3·84
Alumina	18·5	19·6	23·70	1·5	0·00
Potash	2·0	2·7	0·00	0·0	0·00
Water	2·0	11·4	9·16	6·0	3·40
	99·5 Vauq.	100·3 Berthier	98·98 Thom.	100·0 Vauq.	99·34 Thomson.

The first three present so great a discrepancy in their chemical composition that no formula can be deduced from them. The last analysis, which was instituted on the purest form of the species, gives this formula: $MgS^2 + MgS^3 + \frac{1}{2}Aq$. B B, some varieties lose their color, and are difficultly fusible; others (the green-earth in particular) are changed into a black scoria, and, probably from their deficiency in potash and magnesia, will not fuse at all.

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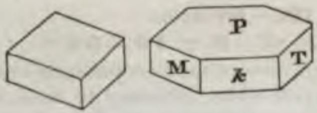
* Whence Chlorite, from the Greek, signifying green.



P on M or T 90° 00′
M on T . . 60 00
——— k ⎫
or ⎬ 120 00
T on k ⎭

The above figures and measurements are given on the authority of Haüy.

Compact chlorite is amorphous; chlorite-slate possesses a slaty structure; and earthy chlorite consists of slightly coherent scaly particles.

One of the most beautiful dark-green foliated chlorites occurs in the Taberg iron mines of Wermeland in Sweden; the grey variety is found in Aberdeenshire. In Cornwall, where it is known under the title of *Peach*, some of the more crystalline kinds are met with in metallic veins. Apple-green colored talc, in large foliated masses, occurs in the island of Unst, one of the Shetlands; also in the Greiner Mountain in Saltzburg; in the Tyrol, and in the Vallais. The same, deposited in stellular concretions, imbedded in quartz, is found in Sweden; and a beautiful massive and translucent white variety at Almorah, in the Himalayah Mountains.

1. NACRITE. Talc Granuleux of Haüy. There seems no longer any propriety in retaining this mineral as a distinct species; all its characters allying it with common talc, or chlorite of the present work, the editor has assigned it to that place. It is evident, however, that the name nacrite has been applied to substances widely different in chemical composition: that so called from Brunswick, Me., analyzed by Dr. Thomson, contains alumina instead of magnesia, and is a variety of common mica. That of which the analysis is given by Vauquelin, still more closely resembles mica by its containing both potash and alumina; while that from Smithfield, R. I., is manifestly a magnesian mineral, having the unctuous feel of steatite, and wanting in the laminæ the flexibility of mica. Smithfield, R. I., and Bridgewater, Vt., afford the finest specimens of talc hitherto met with in the United States. Common chlorite is of very frequent occurrence.

2. GREEN EARTH. Grünerde, W. Talc Zographique, H. Is met with in small masses, in, or lining the cavities of, amygdaloid; and is of a greyish- or bluish-green color, passing into blackish-green; it is dull, and yields to the nail: its fracture is generally earthy. It is found wherever amygdaloid occurs: as in Saxony, Bohemia, Monte Baldo near Verona; in the islands of Faroe, and in many parts of Great Britain. When of a good color it is made use of by painters. Green earth is a very common ingredient in the amygdaloid of Nova Scotia.

ZIRCON.

Zircon, W. Pyramidal Zircon, J. M. Zircon, H. Carbunclus quadratus, D.

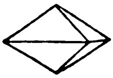
Combination of zirconia and silica.

	Buncombe, N. C. *Zirconite.*	*Hyacinth.*	*Zirconite.*
Zirconia	67·07	66·00	67·16
Silica	32·08	33·32	33·48
	99·15 Vanuxem.	99·32 Muir.	100·64 Berzelius.

The mean of these analyses gives 1 atom silica, 1 atom zirzonia, or a simple silicate of zirconia, for the composition of this mineral. Formula: ZrS.

Sp. Gr. 4·5—4·7. H. = 7·5.

1.



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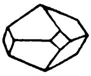

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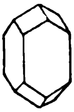

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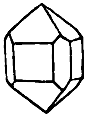

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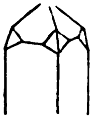
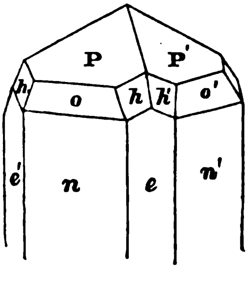


Fig. 1, the primary octahedron. Fig. 2, the same, having its lateral solid angles replaced. Fig. 3 is the same as fig. 2; but the replacement of its angles is so considerable as to give to the crystal the form of a quadrangular prism terminated by four-sided pyramids with rhombic planes. In fig. 4 the edges formed by the meeting of two pyramids of the primary octahedron are also replaced. Fig. 5 shows the solid angles formed by the meeting of the prism and pyramid, replaced each by two planes.



P on P, or P′ on P′ over the summit	95°	40′
P on P′	123	15
P on *n* or P′ on *n′*	132	10
P or P′ on *e*	118	12
P on *o*	153	15
P on *h* or P′ on h′	150	12
h on *h*	147	12
h or *h′* on *e*	147	50
h on *h*	133	00
e on *e′*	90	00
n on *n′*	90	00
n or *n′* on *e*	135	00
h on *n* or *h′* on *n′*	148	17
n on *o*	159	35

The primary form is an obtuse octahedron, with a square base, which occurs only among the opake brown crystals: its angles, taken by the reflecting goniometer, on natural planes, are 84° 20′, and 95° 40′. The crystals of this substance resemble in a remarkable degree those of the oxide of tin, which also have for their primary form a flat octahedron: they are doubly refractive when translucent, are harder than quartz, and their lustre is adamantine. B B, a pure fragment loses its color, but retains its transparency, and does not melt. With borax it melts into a transparent glass. It is not acted upon by acids.

In the United States, at Buncombe, N. C., Dr. J. D. Porter discovered a large number of crystals scattered through a hill composed of disintegrated gneiss. The locality has since supplied mineralogists with many interesting crystals; but though of large size, they have not the beautiful color and transparency of those from other places, particularly from Hammond, N. Y., where perfectly polished prisms, under the common elongated form (*prismé* and *plagièdre* of Haüy), resulting from the replacements of the basal edges of the octahedron, have been obtained, nearly two inches in length, and with both terminations entire. They are imbedded in a white crystallized limestone, and accompanied by graphite, opalescent felspar, sphene and beryl, the whole forming a bed in gneiss. Good crystals have been found at Warwick, Edenville, and Munroe, N. Y., and at Middlebury, Vt. Very handsome and brilliant forms also occur in talcoze slate at Easton, Penn., and Haddam, Ct. According to Prof. H. D. Rogers, fine crystals of zircon occur in the limestone beds of East Bradford and East Marlborough, Penn., associated with beryl, red oxide of titanium, epidote, and tremolite.

Zircon is divided into three sub-species: Hyacinth, Jargoon and Zirconite.

1. The *Hyacinth* presents various shades of red, passing into orange red; it is transparent or translucent; its structure is lamellar, yielding to cleavage parallel both to P and *n* of the above figure. Its cross fracture is conchoidal, with a vitreous lustre. B B, alone, it is infusible, but with borax melts into a diaphanous glass. The hyacinth is commonly found in grains or rolled masses in the beds of rivers. It occurs in the brook Expailly, in Auvergne; at Ohlapian in Transylvania; near Billin in Bohemia, and in the alluvial deposites of Ceylon: occasionally, also, imbedded in volcanic tuff in Auvergne; at the Laachersee, near Bonn; and at Vesuvius.

2. The *Jargoon* occurs in small transparent or translucent prismatic crystals (fig. 3), of a grey, yellow, or brown color, having frequently a smoky tinge. It is found in the sands of certain rivers in Ceylon, with spinel, sapphire, and iron sand.

3. The *Zirconite** occurs in reddish-brown and nearly opake prismatic crystals (figs. 4 and 5). Of these, magnificent specimens, occasionally as large as a walnut, are found at Miask in Siberia, at Kitiksut in Greenland, and in the zircon sienite of Fredrickswärn, in Norway. In smaller crystals it

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* Zirconite, from its containing the earth Zirconia.

is found in several granite and gneiss rocks, as at the Sau-alp in Carinthia, at Scalpay in the Isle of Harris, and elsewhere.

The varieties of zircon are cut and polished by the lapidary, but in general are not greatly esteemed. The hyacinth, however, often exhibits a brilliant color when set as a gem.

SILLIMANITE.

Bowen. (*Amer. Jour. of Sci.*, vol. viii., p. 113.) Epimacius Sillimanianus, D.

Combination of silica, alumina, and zirconia.

This mineral was analyzed in 1824, by G. T. Bowen, and named by him in honor of Prof. Silliman. He published his examination of it in vol. viii. *of the American Journal of Science.* More recently it has been analyzed by Dr. Muir, (*Edinburgh Transactions*, xi., 245,) whose results have added much new interest to this mineral by the discovery of zirconia as one of its essential constituents. The following are the two analyses:

Alumina	54·11	Alumina	35·10
Silica	42·67	Silica	38·67
Peroxide of iron	2·00	Zirconia	18·51
Water	0·51	Peroxide of iron	7·21
	99·29 Bowen.		99·49 Muir.

With the alumina of the first analysis is probably contained the zirconia of the second; but another analysis of the mineral seems very desirable.* Dr. Thomson, relying on the last, makes the constitution of the mineral to be 3 atoms silicate of alumina and 1 atom silicate of zirconia. Formula: $3\mathrm{AlS}+\mathrm{ZrS}$.

Sp. Gr. 3·41. H. = 6·0 — 6·5.

Primary form an oblique rhombic prism of 106° 30′, the inclination of the base to the axis being 113°. Occurs imbedded in quartz in bent and twisted crystals, whose planes being dull and somewhat convex, seldom admit of accurate measurement. Color dark grey, passing into clove-brown; translucent on the edges. Lustre vitreous, considerable on the face of cleavage, which is parallel to the shortest diagonal of the prism. Fracture uneven, splintery. Brittle, and easily reduced to powder. Infusible B B, *per se*, nor does it melt into a bead with borax. It was formerly regarded as a variety of anthophyllite, which, in several respects it closely resembles, but from which it may easily be distinguished by its superior hardness. Shepard identifies it with bucholzite, and thinks that future analyses of the latter mineral will discover the presence of zirconia, which is now supposed to constitute the principal difference between them. It is to be observed, however, that Dr. Thomson's more recent analysis of bucholzite failed to detect the presence of that substance. They differ in other respects, and it seems better, for the present, to describe them as distinct species.

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* A new analysis has more recently been made by Arthur Connell, but without showing the presence of zirconia; and the specimen was evidently genuine. His results are thus stated: silica 36·75, alumina 58·94, oxide of iron 0·99. There can be no doubt, I think, that zirconia was found in the mineral analyzed by Muir, and the specimen was received from Prof. Nuttall; but from which locality it came, we are not informed. I am unable to explain the discrepancy in the analyses, and Mr. Connell's paper met my eye only in season to be referred to in this note. (See Jameson's Edin. Phil. Jour., vol. xxxi., p. 235.) [Am. Ed.]

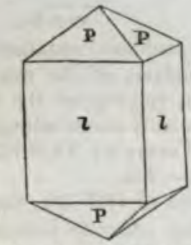
Sillimanite occurs in long, slender, prismatic crystals, traversing layers of quartz in gneiss, at Chester, Ct. These prisms are sometimes bent at the middle nearly at right angles, apparently while in a soft state: an appearance sometimes observed in kyanite. It is found also at Norwich, Ct., at the Falls of the Yantic, and is accompanied by blue corundum and felspar. The crystals are rounded, and sometimes bent nearly at right angles.

OSTRANITE.*

Breithaupt. (*Edin. New Phil. Jour.*, vol. iv., p. 186.)

Sp. Gr. 4·32 — 4·4. H. between 4·0 and 6·0.

Occurs in four-sided prism surmounted by four-sided pyramids.



P on P	the adjacent angles of the pyramid	128° 14′ 133 42
l on *l*	the adjacent angles of the prism	96 00 84 00

This mineral bears considerable resemblance to zircon, both in form and appearance; its angle however differs. Its color is clove-brown; lustre vitreous; streak inclining to pale grey; very brittle. It does not fuse B B, but its color becomes paler; with borax it melts, though with difficulty, into a transparent glass. Insoluble in nitric acid. It has not been analyzed.

It is found in Norway, and is supposed to belong to the zircon sienite of Frederickswärn. It is a very rare mineral.

EUCLASE.

Euklas, W. Prismatic Emerald, J. M. Euclase, H. Beryllus rhomboideus, D.

Combination of glucina, silica, and alumina. Glucina 21·78, silica 43·22, alumina 30·56, oxide of iron 2·22, oxide of tin 0·70. — *Berzelius.*

Iron and tin being accidental, the formula is $2AlS+GS$.

Sp. Gr. 3·06. H. = 7·5.

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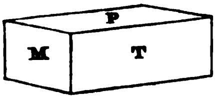
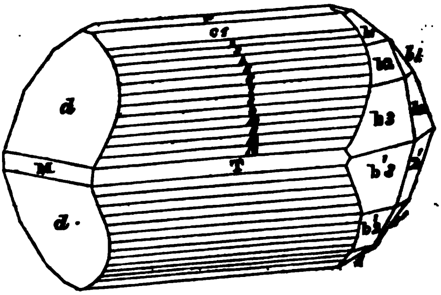
* Ostranite, named by Breithaupt, from the goddess Ostra.

It occurs in crystals which, when held in one direction, may be termed prismatic; the prism sometimes appearing rectangular, sometimes rhombic, and variously modified and terminated. The principal cleavage is highly perfect, and easily obtained,* parallel to the plane P of the following figures: it cleaves also parallel to M and T; which, together with the measurements, and the nature of the modifying planes, prove the primary form to be a right oblique-angled prism. The planes P and T, and the intermediate planes (which at first sight appear only as striæ), are those of the apparent prisms of the crystals, which usually are attached to the matrix at M, or the opposite plane. It is either colorless and nearly transparent, light green of various shades, or bluish-green; fracture conchoidal, with a splendent vitreous lustre. Very fragile; possesses double refraction, and becomes electric by friction or pressure, a property which it retains for many hours. B B, it becomes opake, and then melts on the edges into a white enamel; with borax it fuses slowly into a transparent colorless glass. It is not affected by acids.





P on M or T . . .	90°	00′	P on *c* 12	108°	38′
M on T	130	52	—— *c* 13	100	50
T on *b* 1	98	50	—— *b* 1	128	10
—— *b* 2	100	10	—— *b* 2	108	24
P on *c* 1	124	30	—— b 1	130	10
—— *d*	124	24	—— b 2	112	50
—— *c* 1	122	28	—— b 3	139	18
—— *c* 2	121	30	*b* 1 on *b* 2	165	18
—— *c* 3	120	10	*b* 2 on *b* 2′	143	32
—— *c* 4	116	05	b 1 on b 2	162	20
—— *c* 5	112	50	b 2 on b 3	169	45
—— *c* 6	111	50	b 2 on *b* 1	143	20
—— *c* 7	109	40	*d* on d	105	20
—— *c* 8	108	46	*c* 1 on *d*	140	00
—— *c* 9	107	20	———— b 1	148	10
—— *c* 10	106	22	———— *b* 1	115	20
—— *c* 11	105	14			

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* Euclase, from the Greek, signifying easily broken; in allusion to this circumstance.

The above figure represents the planes of some crystals in the possession of H. J. Brooke, from which Mr. Phillips obtained the accompanying measurements by the reflecting goniometer.

Euclase was first found in Peru, in small quantity; and has since been brought from Capao, in the mining district of Villa Ricca in the Brazils. Its matrix is described as chloritic slate, but it is principally known in isolated crystals, which have now become exceedingly rare and costly.

It was found in its gangue (for the first time ever observed) at the topaz and fluor vein of Mr. Lane at Trumbull, Ct. It occurs in thin, transparent, yellowish-white tabular crystals, lining cavities in a silvery-white mica, and sometimes imbedded in a dark purple fluor.*

BERYL.† EMERALD.

Eldler Beryl, W. Emeraude, H. Beril Aigue-marine, Bt. Aquamarine. Rhombohedral Emerald, J. M. Beryllus hexagonus, D.

Combination of glucina, silica, and alumina.

	Emerald, Peru.		*Beryl*, Siberia.
Glucina	12·50	13·00	15·50
Silica	68·50	64·50	66·45
Alumina	15 75	16·00	16·75
Oxide of chrome	0·30	3·25	0·00
Oxide of iron	1·00	0·00	0·60
Lime	0·25	and water 3·60	0·00
	98·03 Klaproth.	100·35 Vauquelin.	99 80 Klaproth.

	Beryl, Broddbo.	*Beryl*, Siberia.	Aqua marine.
Glucina	13·13	12·53	4·50
Silica	68·35	66·85	67·00
Alumina	17·60	18·40	16·50
Oxide of chrome	0·00	0·00	1·00
Oxide of iron	0·73	2·00	0·50
	99·80 Berzelius.	99·78 Thomson.	99·50 Dumenil.

Dr. Thomson from the mean of the above analyses, gives the composition, 2 atoms tersilicate of alumina, 1 atom tersilicate of glucina: $2AlS^3+GS^3$ — which is the same as that given by Beudant.

The only important difference between emerald and beryl is in their colors; which, since they present an uninterrupted series, is altogether insufficient for a division of the present species. The emerald is emerald-green, which it derives from a small proportion of chrome; all the varieties of other colors, tinged more or less yellow and blue, or altogether colorless, are beryl. The common form is a hexahedral prism, which sometimes is deeply striated longitudinally, and terminated by a six-sided pyramid, whose summit is replaced; or the terminal edges and angles of the prisms are replaced by small planes. Readily yields to cleavage parallel to all the planes of its primary form, the hexahedral prism. Transparent, translucent, or opake. Lustre vitreous. Fracture conchoidal and uneven. Transparent varieties become clouded B B, and on increasing the heat, assume the appearance of mother-of-pearl. With borax, according to Von Worth,* emerald gives a transparent greenish vitreous enamel, but beryl, with the same salt, gives a colorless transparent enamel. With salt of phosphorous the former gives the same result as with borax, but beryl gives a milk-white opal-like semitransparent enamel. With fluor spar, emerald from various localities easily fuses into an opake, turquoise-like pearly globule, while beryl of a green, blue and yellow color, gives a milk white opake pearly globule.†

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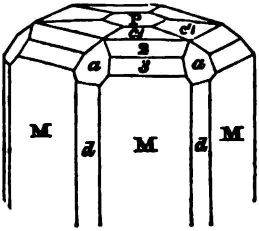
* Prof. Shepard. American Journal of Science, vol. xliii, p. 366.

† Called Beryllos by the Greeks. Aqua Marine from the Latin, *sea-water*, in relation to its color.



P on MM or M	90°	00′
M on M	120	00
P on *a*	135	14
—— *c* 2	150	10
c 1 on *c*′ 1	179	40
M on *d*	150	00

This species occurs principally in veins traversing granite, in implanted crystals, associated with felspar, topaz, tin-ore, &c.; likewise in fractured crystals and rolled masses in secondary depositories. The most splendid crystals of emerald occur in a vein of magnesian limestone, which traverses a hornblende rock at Muso, near Santa Fé de Bogota in Granada; some of these have been found exceeding two inches in length and breadth. One, a perfect hexahedral prism from this locality in the cabinet of the Duke of Devonshire, is three inches long and about one inch in diameter. It is valued at one hundred and fifty guineas. Another in possession of Mr. Hope of London, from the same place, cost £500. Less distinct varieties occur at Mount Zalora in Upper Egypt, the only locality of emerald with which the ancients are believed to have been acquainted; at Cangarjum, in the district of Coimbetoor, in Hindustan; and imbedded in mica slate in the Heubach valley, Pinzgau district, Saltzburg. Recently several very magnificent emeralds have been found in Siberia, in the Wald district, eighty-five wersts from Jekatherinburg, imbedded in mica slate. A twin crystal in the Imperial cabinet at St. Petersburg, is seven inches long, four broad, and weighs, with the accompanying mica slate which may be about a pound itself, five and a half pounds. Another specimen of mica slate resembling a table with rounded corners, fourteen inches long, twelve broad and five thick, shows twenty partly imbedded crystals from half an inch to five inches long, and from one to two inches broad. Crystals of so large a size and possessing equal transparency and richness of color, have never before been found. Von Worth has instituted a comparison between this emerald and that from other countries, in order to ascertain if it contained chrome, as it had been said to contain none, while the mineral from other places owed its fine color to the presence of this metal. The result showed the presence of this substance, though in too small quantity to be obtained by analysis, whence it was probably overlooked by Klaproth.

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* Trans. Imp. Min. Soc. St. Petersburg, vol. i. p. 58.

† Von Worth concludes from his experiments that the fused products of emerald and beryl with fluor spar, must owe their color to different ingredients; the former to oxide of chrome, and the latter to oxide of iron. The chief distinction between the two, therefore, seems to depend on the presence or absence of these two substances. [Am. Ed.]

Figures of several crystals of this mineral may be seen in vol. i. of the *Transactions of the Imperial Mineralogical Society of St. Petersburg;* they are of the natural size and color, and present a most beautiful and unique appearance — the rock itself being imitated by an ingenious artifice. Such varieties of beryl as are clear, transparent, and exhibit very brilliant shades of sky-blue, or mountain-green, are denominated by lapidaries *aqua-marine*, or precious beryl. They are principally from the Brazils, and frequently occur in considerable masses. Of the common beryl, large hexagonal pale-green colored translucent prisms are met with in the granitic district of Nertschinsk, and in the Uralian and Altai ranges of Siberia; they have been found exceeding a foot in length, and, when divested of their matrix, appear deeply striated longitudinally. A coarse nearly opake variety occurs, both crystallized and in large masses, near Limoges in France; and imbedded in granite at Finbo and Broddbo, near Fahlun in Sweden; and others at Bodenmais and Rabenstein in Bavaria. Beautiful crystals, occasionally two or three inches in length, and having a peculiar pale blue color, occur in granite, associated with topaz, felspar, black quartz, and mica, at the Mourne Mountains, County Down.

In the United States, beryl of the most remarkable dimensions have been discovered in Acworth, N. H., imbedded in a vein of coarse granite traversing gneiss. They are regular hexahedral prisms, varying in length from three to four feet, and though usually of a pale greenish or yellow color, and scarcely penetrable by the light, sometimes they present faces, which, to a considerable depth, have all the brilliant transparency of aqua marine, and as such could be used to advantage in jewelry. A few years ago these gigantic crystals could be readily obtained; they have now become scarce. Crystals of a fine blue color have been found in the granite of Parker's Island, on the Kennebec river, Maine, sometimes with six sided pyramidal terminations; and exceeding fifteen inches in length and six in thickness. Smaller specimens of superior color have been obtained from veins of quartz in the towns of Bowdoinham and Topsham, of the same State. At the former place they are so very abundant in the decomposed rock, or loose in the soil, that bushels of them may be obtained without much trouble, but they are of inferior color and mostly stained by oxide of iron. Crystals of highly polished faces and possessing considerable transparency, have been brought from Haddam and Monroe, Conn. But the locality most noted for the beautifully transparent and various colored varieties of this mineral, some of them almost attaining the ultimate perfection of the species, or emerald, is at South Royalston, Mass. Their form is the usual six-sided prism, which commonly shows only a single plane termination, or the primary face P, but is sometimes replaced on its terminal edges, by single planes which meet in a perfect pyramid, or in one having its apex more or less deeply truncated. Some of the prisms have three of the opposite lateral edges replaced by two planes, which are distinguished from the primary faces by their roughness or inferior polish. Their color varies from a light green, pale bluish-green, or yellowish-green, to a deep grass or emerald green. Prof. Hitchcock first brought this remarkable locality to the notice of mineralogists. Interesting localities of beryl have been cited by Dr. Jackson in Grafton, Danbury, and Wilmot, N. H., generally in massive quartz, and sometimes associated with trapozoidal garnet. Fine large crystals of good green color have been found in the quarries on the banks of Ridley Creek, two miles from Chester, Delaware County, Penn., by J. A. Clay.

The beautiful beryls from the "Beryl Mine of Paddioor," Southern India, are imbedded in, or line the cavities of, broad foliated cleavelandite.—*Jameson's Edin. Jour.*, xxix., 243.

CHRYSOBERYL.[*]

Krisoberil, W. Cymophane, H. Bt. Prismatic Corundum, J. M. Chrysoberil, Br. Sapphirus rectangula, D.

Composition according to the analyses of the following chemists.

	Brazil.		Brazil.	Ural.
	Klaproth.	Arfwedson.	Awdejew.	Awdejew.
Alumina	71·05	81·43	78·10	78·92
Lime	6·00	0·00	00·00	00·00
Silica	18.00	18·73	00·00	00·00
Glucina	0·00	0·00	17·94	18·02
Protoxide of iron	0·00	0·00	4·77	3·12
Oxide of chrome	1·05	0·00	0·00	0·65
	97·00	100·16	100·51	100·71[†]

	Brazil.		Haddam.	
	Thomson.	Seybert.	Seybert.	Damour.
Alumina	76·75	68·66	73·60	75·26
Glucina	17·79	16·00	15·80	18·46
Silica	0·00	5·09	4·00	1·45
Protoxide of iron	4·49	4·73	3·38	4·03
Oxide of titanium	0·00	2·66	1·00	0·00
Moisture	0·00	0·66	0·40	0·00
	99·51[‡]	98·70[§]	98·18[‖]	99·20[**]

Dr. Thomson, taking his own analysis, which was three times repeated with the same results, gives this formula: $5\frac{1}{4}GAl^{6}+\underline{F}Al$. This result almost exactly accords with the very recent analysis of the same chrysoberyl by Awdejew.

Sp. Gr. 3·65 to 3·8. H. = 8·5.

This substance occurs crystallized, and in rolled fragments in the alluvial deposits of rivers; its color is green, sometimes with a yellow or brownish tinge, and occasionally presenting internally an opalescent bluish-white light. The primary form of its crystal is a right rectangular prism. The crystals yield to mechanical division readily, and with brilliant surfaces, parallel to the plane M of the following figures, and with difficulty also parallel to the plane T, and to the longer diagonal of the prism; the fracture is perfect conchoidal, with a splendent resino-vitreous lustre. It becomes electric by friction, but is not affected by heat. B B it suffers no change alone; but with borax fuses slowly into a transparent glass. The Ural chrysoberyl (*Alexandrite*) according to Von Worth, melts with borax into a pure, bright green transparent glass; and with salt of phosphorus after long continued action, into a transparent pale greenish enamel, showing the presence of oxide of chrome.

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[*] Chrysoberyl, from the Greek, denoting a superior kind of beryl, or a *golden* beryl. Cymophane, from the same, signifying a floating light, in allusion to its opalesence.

[†] Poggendorf's Annalen, lvi., p. 101.

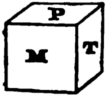
[‡] Outlines of Mineralogy, i., 401.

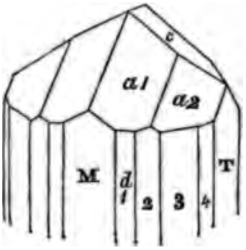
[§] Amer. Jour. of Sci., viii., 109.

[‖] Ann. de Chimie et de Phys., Feb., 1843.

[**] Ibid. viii., 109.

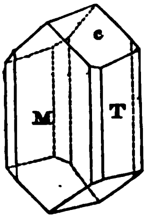
Primary.





M on T	90°	00′	
——— d1	154	51	
——— d2	136	20	
——— d3	125	18	
——— d4	120	55	
——— a1	137	6	
——— a2	128	43	H.
a1 on c	133	19	"
T on a1	110	3	"
——— a2	126	8	"
a1 on a2	163	53	

1



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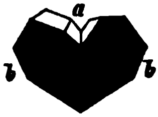

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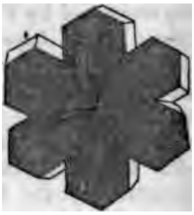

At Haddam in Connecticut it occurs in granite, in six-sided tables and prisms, with garnet, beryl, automalite, and columbite. Also in the same rock with tourmaline, garnet and apatite, at Greenfield, near Saratoga, N. Y. At this locality the crystals are often united in hemitropes, consisting of several individuals whose terminal faces are obliterated by deep replacements of the shorter terminal edges of the primary. A very common form of this mineral from Greenfield, is that of three prisms crossing each other, each projecting at opposite ends beyond the faces of composition, as in fig. 3; or more rarely only at one end, as is represented by the upper half of the same figure. Sometimes crystals are found in which the composing prisms project at neither extremity, thus producing regular hexagonal tables in which the hemitropic composition is indicated only by striae. Fig. 2 represents two individuals the faces of which project at one extremity, and, in some instances, have their lateral edges replaced. Rarely the sides (*b*, *b*,) are so deeply replaced as to convert this figure into a triangular prism, the re-entering angle (*a*) being then no longer visible. This is the rarest form of the macle, now to be obtained at this locality. Fig. 1, shows the primary with its terminal plane obliterated by the extension of the planes which replace the shorter terminal edges, having also its lateral edges replaced by single planes.* The crystals are usually small, but the late Dr. Steele procured several from this locality which were of good color, and more than an inch in diameter.

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* See a paper by Dr. Troost, (Jour. Acad. Nat. Sci., Philad., vol. iii., p. 293.) Also Mineralogy of New York, by Prof. Beck, in which many of the forms of this mineral are figured and described. [AM. ED.]

The finest specimens for lapidaries' purposes, have been brought from Brazil, where, as in Ceylon, it occurs in the alluvial deposits of rivers, and consequently in rolled, and generally much rubbed, masses. When transparent and free from flaws, it forms a handsome gem. If opalescent, it is usually cut *en cabochon.*[*]

ALEXANDRITE. Chrysoberyls of great value have recently been discovered in the Ural mountains. They have been carefully described by Von Worth in the first volume of the *Transactions of the Imperial Mineralogical Society of St. Petersburg;* and the description is accompanied by figures of the natural size and color, with the matrix of mica slate on which they are implanted, so perfectly imitated, that we seem almost to have the real gems before us. These gems possess a peculiar dichroism which is not changed by exposure, *per se*, to the action of the blow pipe, appearing when the light falls upon them of a beautiful leek or emerald green color, and when it passes through them of a deep raspberry red or violet. This peculiarity is so remarkable that those who witness it in the evening, when the crystal is brought in the dark to a flame, will doubt by day-light the identity of the specimen, when it shows the rich green color. Von Worth's experiments show that oxide of chrome is the coloring substance to which the phenomena above referred to, and observed so strikingly in no other stone, are owing. The crystals, sometimes single, are also in regular groups or macles, consisting of three individuals crossing each other in the same manner as those already described. They are sometimes more than three inches in length. The name Alexandrite was given to distinguish this variety from the common chrysoberyl of Ceylon, and because of its discovery on the day of the Emperor's majority. Besides, it has the two principal military colors of the Russian empire — green and red.

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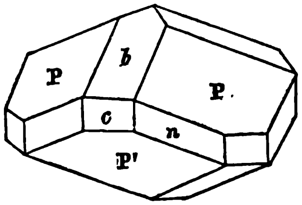
[*] It is to the sagacity of an able American annalist, Henry Seybert, that we owe our knowledge of the true nature of this mineral. In 1822, he analyzed the Haddam and Brazilian chrysoberyl, and detected in both the presence of glucina, though the latter had been previously analyzed by Klaproth and Arfwedson, both of whom had overlooked that substance. Dr. Thomson has more recently fully verified the result obtained by Seybert, which is the more important, as Beudant has adopted the analysis of Arfwedson, though aware of what Seybert had done; and others seemed undetermined as to the true nature of the mineral. I have thought it proper to record each of the several analyses which have been made, and it appears from them not a little extraordinary that while the analysis of Dr. Thomson showed that this mineral contained no silica whatever, Arfwedson should obtain nearly nineteen per cent. It is evident that the latter, not thinking to look for glucina, confounded this earth with alumina; but it seems scarcely possible that he could have mistaken glucina or alumina for silica. The mineral has not been analyzed by Berzelius, but H. Rose has confirmed Dr. Thomson's result in proving the absence of silica. We are thus equally indebted to Seybert and Dr. Thomson for our most accurate knowledge of the chemical constitution of this species. [AM. ED.]

PHENAKITE.

Nordenskiold. (*Pogg. Ann.* xxxi. 57.) Bisilicate of Glucina. Berryllus rhombohedrus, D.

Contains silica 55·14, glucina 44·47, alumina and magnesia 0.39. — *Hartwall.* Formula: GS^2. Sp. Gr. 2.969. H. above 6·0. Primary form a rhomboid of 115° 25′, the edges and angles of which are usually replaced.



P on *b* . . . 147 42′

P on *n* . . . 122 17

Cleavage parallel to *n*. Color bright wine-yellow, inclining to red or white. Varying from transparent to opake. Lustre vitreous. Not affected by acids, and with difficulty fusible B B.

Occurs associated with beryl in the Perm district of Siberia. At first sight it is described as being readily mistaken for quartz; and is hence named from *φεναξ, the deceiver.* It has also been found near Freiberg and near Framont, specimens of which have been examined by Bischof, and found to have the same composition with the Siberian.

GADOLINITE.

Gadolinit, W. Gadolinite, H. Prismatic Gadolinite, J. M. Melanophæus obliquus, D.

Combination of yttria, silica, glucina, and the oxides of cerium and iron. The oxide of cerium was first noticed in it by Berzelius, though it had been previously analyzed by Godolin, Klaproth and Vauquelin; but Berzelius overlooked glucina, which was first detected in the mineral by Ekeberg.

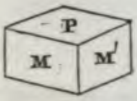
	Karafvet.	Ytterby.	Ytterby?	Broddbo.
Silica	25·80	23·0	24·33	27·10
Yttria	45·00	55·5	45·33	36·54
Glucina	0·00	4·5	11·60	5·90
Protoxide of cerium	17·92	0·0	4·33	14·31
Protoxide of iron	11·43	16·5	13·59	14·41
Lime	0·00	00·0	0·00	0·45
Moisture	0·00	00·0	0·98	0·00
	98·35 Berzelius.	99·5 Ekeberg.	99·16 Thomson.	98·71 Connell.

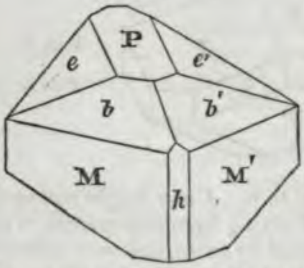
It is essentially a silicate of yttria united with variable proportions of oxides of cerium and iron.

Sp. Gr. 4·2 to 4·3. H. = 6·5 — 7·0.

In imperfect oblique rhombic prisms. Color iron-black, and dull externally, internally black and shining; its primary form appears to be an oblique rhombic prism. Translucent on the edges, or opake. Cleavage imperfect. Fracture conchoidal. B B, the Karafvet variety decrepitates, and fuses, when strongly heated, into an opake pearl-grey or reddish glass; that from Ytterby incandesces and loses its color, but does not fuse. With borax they all melt readily into a globule, more or less tinged with iron, and which in the reducing flame becomes dark bottle green. In heated nitric acid it loses its color and gelatinizes.

Primary.





M on M′ . .	115°	0′
P on *h*	98	0
M on *e*, or M′ on *e′*	100	0
M on *b*, or M′ on *b′*	153	0
b on *b′*	120	0
e on *e′*	120	0
b on *e* or *b′* on *e′* . .	130	0

The above figure represents a crystal in the possession of Mr. Brooke.

Its principal localities are the quarries of Karafvet and Finbo, near Fahlun in Sweden. Both there, and at Ytterby near Stockholm, it occurs indistinctly crystallized, and in amorphous masses, which are often encircled with a yellow crust, and are imbedded in coarse-grained granite. It has likewise been noticed at Disko in Greenland, and imbedded in granite in Ceylon. It received its name from Prof. Gadolin, its discoverer.

THORITE.

Berzelius. (*Kong. Vet. Acad. Handl.*, 1829, p. 1.) Melanophæus Thoriferus, D.

Thorina 57·91, lime 2·58, oxide of iron 3·40, oxide of manganese 2·39, oxide of uranium 1·58, oxide of lead 0·80, silica 18·98, water 9·50, with minute proportions of magnesia, potash, soda, and alumina. — *Berzelius.* Sp. Gr. 4·63. Not scratched by the knife. Formula: $3\mathrm{ThS}+(\mathrm{Cal}, \underline{\mathrm{F}}, \underline{\mathrm{M}}, \&c.)\mathrm{S}+1\frac{1}{4}\mathrm{Aq}$.

Massive and compact. Color black. Streak dark-brown. Fracture vitreous, like that of gadolinite. B B it gives off water, and becomes yellow, but does not fuse; in a glass tube it exhibits traces of fluoric acid; with borax it forms a glass colored by iron; and in salt of phosphorus fuses, with the exception of its silica.

This species was discovered by M. Esmark, in syenite, near Brevig in Norway. The metal *Thorium* was first discovered in this mineral by Berzelius.

TAUTOLITE.

Breithaupt. (*Phil. Mag.*, new series, iii., 398.)

Sp. Gr. 3·865. H. = 6·5 — 7·0.

Opake, and of a velvet-black color, with a vitreous lustre, and grey streak. Cleavage only in traces, and interrupted. Fracture conchoidal, uneven. Very brittle. B B it melts into a black scoria, which acts on the magnet; and with borax forms a clear green glass: with solution of cobalt it presents a blue color; and, on the whole, appears to be a silicate of the protoxide of iron, combined with a silicate of magnesia.

It occurs in volcanic felspar at the lake of Laach, near Bonn on the Rhine. It is related to chrysolite, but we have no analysis of it.

POONAHLITE.

Brooke. (*Annals of Philosophy*, vol. x., 1831.)

This mineral has been analyzed by Gmelin,* and found to consist as follows:

Silica	45·120
Alumina	30·446
Lime	10·197
Soda with a trace of potash	00·657
Water	13·386
	99·806

Chemical formula given by Gmelin: $3\dot{Ca}\dddot{Si}+5\dddot{Al}\dddot{Si}+H$.

H. = 5·0 — 5·5.

It resembles needlestone in most of its physical characters, and is supposed to have the same primary form — a right rhombic prism — but differing in the measurement of the angle formed by the planes M M′, as determined by Brooke. No natural terminal planes have been observed among the crystals, which, usually in long slender prisms, traverse the surface of the matrix, instead of forming groups in its cavities, and thus have neither of their extremities free. It occurs with the beautiful green apophyllites near Poonah, in Hindustan, and is accompanied also by pure white stilbite. Its matrix is an amygdaloid filled with nodules of zeolite and much stained by green earth. The specimens of this mineral in the possession of Mr. Heuland, of London, are of unsurpassed magnificence, and by this gentleman the mineralogists of other countries have been supplied.

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* Poggendorf's Annalen, B. xlix.

DANBURITE.

Shepard. (*Am. Jour. of Science*, vol. xxxiii., p. 137.)

This mineral which has been described as a new species, occurs disseminated in small quantities through a fetid felspar at Danbury, Ct. It occupies small cavities which have apparently the shape of oblique prisms.

A chemical examination by Prof. Shepard gave the following results.

Silica	56·00
Lime	28·33
Alumina	1·70
Yttria	0·85
Potash, and perhaps with soda and loss	5·12
Water	8·00
	100·00

It is not certain in what manner the alkali enters into the composition of this mineral, and the principal combination may probably be correctly stated thus: $\mathrm{CalS^3+Aq}$.

Sp. Gr. 2·83. H. = 7·5.

Its color in fresh specimens is honey-yellow, but the decomposing variety is nearly white, translucent and very fissile. Streak white; transparent. Lustre vitreous, in a high degree. Primary form an oblique rhombic prism, with cleavage parallel with P, obscurely indicated by fissures. Character B B, not given. It deserves further examination.

PIKROPHYLLE.

A. J. Svanberg. (*Trans. Swedish Roy. Sci. Acad.*, 1839, p. 95.)

This mineral, found by M. Sevén of Sahla, Sweden, occurs in the mine of that place at the depth of about forty fathoms, associated with other substances. It resembles most in appearance the so called infusible salaite. Its color, however, is darker, and at the same time its hardness and specific gravity differ materially from the salaites, which led to the chemical examination of the mineral by Svanberg, according to whom it consists of the following ingredients.

Silica	49·80
Alumina	1·11
Lime	0·78
Magnesia	30·10
Protoxide of iron	6·86
Water	9·83
	98·48

Regarding the magnesia as the only essential base, the atoms of silica are 24·90, while those of magnesia are 12·40, showing the mineral to consist essentially of bisilicate of magnesia. But Svanberg includes the alumina with the silica, and regards also as essential the lime and oxide of iron, which he includes with the magnesia; whence he deduces the formula — $3MgS^2+2Aq$.

Sp. Gr. 2·73. H. — between mica and calc-spar.

Color very dark green; lustre glistening, somewhat like that of diallage. It is amorphous, but has an internal crystalline structure, the faces of the crystals being the natural cleavage planes of the laminæ. It does not fuse B B, even in the thinnest splinters, but at a red heat becomes nearly white, with the preservation of its lustre. With the solution of cobalt, it gives the reaction of magnesia. Heated in a glass tube, it gives out pure water. It contains no alkali. The mineral has obtained its name from πικρός, bitter, and φυλλον, leaf, in consequence of the great quantity of magnesia it contains, and because of its structure, which may be called leafy. It is unfortunate that it has not afforded more well defined characters in establishing its claim as a distinct species.

OTTRELITE.

M. Descloizeaux and M. Damour. (*Annales des Mines*, 1842, t. ii., p. 357.)

This mineral, scarcely known hitherto even as a variety, has been classed with diallage. It received its name from Ottrez, a small village near Stavelot, near the provinces of Luxembourg and Liege. It has been described by the first named gentleman and analyzed by the latter. It consists of —

Silica	43·34
Alumina	24·63
Protoxide of iron	16.81
Protoxide of manganese	8·03
Water	5·63
	97·88

Whence is deduced the formula — $2AlS+(\underline{F},\underline{Mn})S^2+Aq$ — which does not apply to any aluminous silicate already known.

Sp. Gr. 4·40. Scratches glass with difficulty.

Its color is greyish black, or a little greenish, which last is most visible on the minute fragments which are translucent. Sometimes it is of a beautiful rose color. Its powder is of a pale green. Occurs in small flat discs of about one and a half inches in diameter, to one quarter of an inch in thickness. These adhere so firmly to the slate which serves as a gangue to them, that it is impossible to separate them entire in order to measure their angles. They belong to a hexagonal prism, or to a very acute rhomboid, deeply truncated by a plane perpendicular to the axis, and compressed in the direction of this plane. Cleavage is easily effected parallel to the terminal faces of the little discs, developing a brilliant, but undulated surface; otherwise, the fracture is unequal, slightly granular and dull. In a closed tube, it gives out a little water. Alone, B B, it fuses with difficulty on the edges into a black globule easily attracted by the magnet. With borax, dissolves slowly and gives the reaction of iron; with carbonate of soda on platina foil, it shows the presence of manganese. Its powder is affected only by hot sulphuric acid. It occurs abundantly in a transition clay slate through which the crystals are disseminated.

VILLARSITE.

M. Dufrénoy. (*Annales des Mines*, 1842, t. i., p. 387.)

This mineral has been examined and made into a new species by M. Dufrénoy of the School of Mines, and named in honor of the mineralogist who has published the natural history of Dauphiné. It is scattered in a vein of magnetic iron ore at Traverselle, and is accompanied by laminated dolomite, mica, quartz and dodecahedral crystals of the iron ore. It forms irregular veins, and also geodes in which crystals may be observed distinct enough to measure. Its analysis gave as follows:

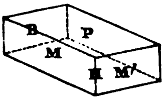
Silica	39·61
Magnesia	47·37
Protoxide of iron	3·59
Protoxide of maganese	2·42
Lime	0·53
Potash	0·46
Water	5·80
	99·77

These numbers reckoning the atoms of iron, manganese and lime along with the magnesia, show the mineral to be a simple hydrous silicate of magnesia, thus expressed by the formula: $4MgS + Aq$.

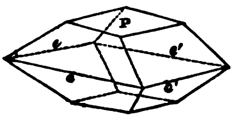
Sp. Gr. 2·975. H. $= 3 - 4$.

Color yellowish-green; fracture granular, resembling certain of the phosphates of lime from Arendal. Its softness and semi-transparency make it also analogous to serpentine. But it is easily frangible, and in separating the mineral from its gangue, the internal crystallization is developed, by which the granular structure is shown to be owing to an assemblage of minute truncated octahedral crystals, joined to one another, or penetrating each other, in all directions. These are rhomboidal octahedrons derived from the replacement of the edges of the summits of a right rhombic prism of 119° 59′ and 60° 1′, which is its primary form. The length of the side B is to the height H, in the proportion of 10: 4, 45; it follows that the vertical axis of the octahedron which constitutes the secondary form of this mineral, is represented by 8, 90, and that the secondary faces rise upon the edges of the base of the prism by a decrease of one row in height on one row in breadth. The angles as determined by M. Dufrénoy, by the reflecting goniometer, are thus stated.

Primary.



P on M . . .	90°	
M on M . . .	119	59′
P on *e* . . .	136	32
P on *e′* . . .	136	32
e on *e* . . .	139	45
e on *e* . . .	86	56



B B, it gives a green enamel when melted with ten parts of borax. It is finally soluble in strong acids, but the weak action of acids upon it allows the crystals to be removed from the adhering dolomite which is readily dissolved. M. Dufrénoy observes that without the water it contains, villarsite would have the same composition with peridot. But this water is essentially combined, and the other characteristics, physical and crystallographical, are alike opposed to its being regarded as identical with it. The mineral excites a certain interest by the simplicity of its composition; and its determination as a species, founded at the same time on the two principles which as much as possible should be our guides, is very clearly defined.

SILICITE.

Dr. Thomson. (*Lon. Edin. and Dublin Phil. Mag.*, 1843, xxii., 190.)

The name Silicite has been given by Dr. Thomson to a substance from Antrim, which strikingly resembles quartz in its external characters, though it differs entirely from that mineral in its constitution. His analysis of it gave,

Silica.................	54·80
Alumina	28·40
Protoxide of iron......	4·00
Lime..................	12·40
Water.................	0·64
	100·24

If we suppose the oxide of iron to be combined with alumina and to be only accidentally present, the constitution of silicite will be $7(\mathrm{AlS}^2)+2(\mathrm{CalS})$.

Sp. Gr. 2·666. H. about the same as rock crystal.

The color is white with a shade of yellow, the texture foliated, and the fracture small conchoidal. Its lustre is vitreous. It occurs in basalt, and is not mentioned as having been found crystallized. With carbonate of soda it fuses into an opake bead, and with borax into a transparent colorless bead.

BALTIMORITE.

Dr. Thomson. (*Lon. Edinb. and Dublin Phil. Mag.*, 1843, xxii., 191.)

This mineral forms a constituent of the chrome bearing rocks in the vicinity of Baltimore, Md. It was sent to Dr. Thomson for examination, and he has named it from its locality under the character of a new species. Its analysis afforded him, silica 40·95, magnesia 34·70, protoxide of iron 10·05, alumina 1·50, water 1260. Its constitution may be represented by the formula, $14(\text{MgS})+3(\frac{3}{4}\underline{\text{F}}+\frac{1}{4}\text{Al})\text{S}^2+11\text{Aq}$.

The color is greyish-green. The mineral is composed of longitudinal fibres, adhering to each other, and has a considerable resemblance to asbestus; the lustre is silky. It is usually opake; but when very thin it is translucent on the edges. It is a very little softer than calcareous spar. It does not fuse B B, but assumes a brown color. With soda melts into an opake, and with borax into a transparent bead.

This mineral has been described as asbestus, which in some of its characters it considerably resembles, but asbestus contains more silica and a good deal of lime, which are wanting in this mineral. It occurs in considerable masses.

ESMARKITE.

M. Erdmann. (*Jameson's Edinb. Phil. Jour.*, vol. xxxii., p. 148. *Ann. des Mines*, 1842, t. xi., p. 476.)

Under this name (which, however, has been previously applied to another mineral by Hausmann) Erdmann has described a substance found near Brevig, in Norway, in granite, accompanied by chlorite, titaniferous iron and tourmaline. It is composed as follows: silicic acid 45·97, alumina 32·08, magnesia 10·32, protoxide of iron 3·83, protoxide of manganese 0·41, water 5·49, lime, oxides of copper, lead, cobalt, and titanium 0·45. Formula: $(\text{Mag}, \underline{\text{F}}, \overline{\text{Mn}})\text{S}^3+3\text{AS}+\text{Aq}$.

Sp. Gr. 2·709. $\overline{\text{H}}$. = 3—5.

It is crystallized in the form of large, irregular individuals, which seem to be prismatic, with the edges and angles rounded; they are for the most part covered with a glittering coat. The crystals have an evident cleavage at right angles to the principal axis, and this cleavage has a feeble pearly lustre. The longitudinal fracture has a resinous lustre. B B, gives water and becomes bluish grey; melts on the thin edges only, to a green glass; fuses with borax and microcosmic salt, with the color of iron; gives a yellow slag with soda.

PYRRHITE.

Prof. G. Rose. (*Jameson's Edinb. Phil. Jour.*, vol. xxix., p. 187.)

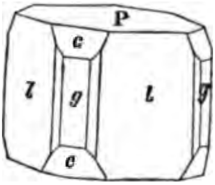
But one example of this mineral is known, and occurs in a splendid drussy cavity of felspar which is in the possession of M. Von Perowski of St. Petersburg. It was found at Alabaschka near Mursinsk. It has not been analyzed.

While the cavity chiefly contains felspar crystals several inches in size, finely defined,and of an ochre-yellow color,* it likewise includes six-sided tables of reddish-white, pearly lithion mica; white translucent crystals of albite; crystals of clove-brown rock-crystal; and a few white topazes. The crystals of the new mineral are superimposed on the felspar, are eight in number, and are octahedrons of about three lines in length. Their surfaces are smooth, but possess little lustre, so that their angles cannot be measured with great accuracy; but, from observations made on several angles, the mean may be regarded as 109° 28′, so that we may probably assume that the crystals are regular octahedrons. No cleavage is observable. The color is orange-yellow, and the lustre feebly vitreous. The substance is translucent on the edges; its hardness is that of felspar, but the specific gravity could not be determined.

SOMERVILLITE.

Brooke. (*Brande's Quarterly Journal*, xvi., 274.)

Colour pale dull yellow. Lustre vitreous. Cleavage perfect, parallel to P. Its primary form is a square prism.



c on *g*	122°	55′
P on *c*	147	5
P on *l*	90	0
l on *g*	135	0
l on *l*	90	0

It decrepitates B B, fusing *per se* into a grey colored globule, and with borax into a transparent one.

Somervillite occurs among the ancient scoriæ of Vesuvius, associated with black mica and other minerals. The determination of this species is due to Brooke, who named it in compliment to Dr. Somerville, from whom he obtained the specimens. It may be distinguished from idocrase by its comportment B B, as the latter does not decrepitate; and when it fuses, which it does with greater difficulty, it yields globules of a greenish tinge. The Humboldtilite of Monticelli and Covelli, according to Brooke, is identical with this mineral.

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* The name was given to it on account of its yellow color.

CLASS II.

ALKALINO-EARTHY MINERALS.

The minerals included under this term generally consist, primarily, of earths in various proportions; they include also some portion of one or more of the alkalies, giving them a very important chemical distinction. Many of them contain iron, and some of them manganese. These are sometimes essential to the constitution of the species, and sometimes to be regarded as accidental. The alkalies are not always in sufficient quantities to be expressed in the atomic formulæ.

MAGNESIAN MICA.*

Glimmer, W. Mica, H. Rhombohedral Talc Mica, M. Mica Rhomboedrique, or Mono Axial, *Necker*. Mica hexagona, D.

Sp. Gr. 2·8 to 3. H. = 2 = 2—5.

Recent optical investigations have pointed out to mineralogists the necessity of separating the varieties of mica which possess only one axis of double refraction, from those which present a double system of rings when viewed through the medium of polarized light.

This species exhibits one axis of double refraction; — a lamina placed between two polarizing tourmalines presents only one system of colored rings, traversed by a black cross. Occurs in regular six-sided prisms, which cleave with extreme facility in one direction, viz., perpendicular to their axis. Color generally dark-green or brown; varying between transparent and opake. Lustre pearly, often inclining to metallic on the terminal faces of the prism; streak white or grey; thin laminæ are flexible and very elastic.

The varieties of this species differ also from the following in containing several per cent. of magnesia, and without a trace of lithia, which is usually found in the common mica, and particularly in the violet, or peach-blossom colored varieties (lepidolites.) They may therefore be very properly distinguished as magnesian micas.

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* Mica, in allusion to its property of shining.

	Black, Siberia.	Siberia.	*Greenish-black,* Siberia.
Potash	10·0	7·55	5·61
Silica	42·5	42·50	40·00
Alumina	11·5	16·05	12·67
Magnesia	9·0	25·97	15·70
Oxide of manganese	2·0	0·00	0·63
Fluoric acid	0·0	0·68	2·10
Peroxide of iron	22·0	4·93	19·03
	97·0 Klaproth.	104·55 Rose.	95 74 Rose.

The formulæ that would express the atomic constitution of this mineral according to each of these analyses, would differ so much from each other, as to show that the specimens must have been very impure, or else indicate more than one species. We shall therefore omit them; and the more readily as the subject is now engaging the attention of several of the most distinguished chemists.

B B, it sometimes fuses into a scoria, but generally becomes white and opake. The characters are as variable as the composition.

To this species belong the dark-colored micas from Siberia; the deep-brown, transparent, and perfectly formed six-sided prisms, which occur in the ejected debris of Vesuvius; and the black hexagonal prisms from the basalts of the Rhine and the trachytes of Hungary. Its abundance in nature, however, bears no proportion to the universal diffusion of the following.

In the United States, a very beautiful variety of this species in low six-sided prisms replaced on all of their edges by single planes, occurs in the iron mine at Troy, Vt., accompanied by small botryoidal concretions of chalcedony. The crystals are nearly transparent, and of a very deep green. Other examples doubtless exist, which have not yet clearly been distinguished from common mica.

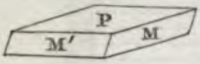
COMMON MICA.

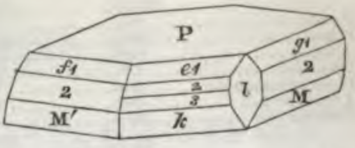
Glimmer, W. Hemi prismatic Talc Mica, M. Mica Prismatique ou Di-Axial, *Necker.* Lepidolite. Mica obliqua, D.

Sp. Gr. 2·85. H. = 2 — 2·5.

Color white, grey, light-green, pale-violet, rose-red color or peach-blossom, brown, and sometimes grass-green. Lustre more or less pearly. Streak white or grey. Separates in lamina which are flexible and elastic, and are capable of indefinite subdivision. These characters are possessed by both species. It exhibits two axes of double refraction; — a lamina placed between two polarising tourmalines presents two systems of colored rings, each traversed by a single black band. Occurs in oblique rhombic prisms of 60° and 120°, which are easily divisible parallel to their terminal plane (P of the following figures).

Primary form.





M' on M	60°	00'	P on e2	94°	30'
P on M'	98	40	—— e3	92	55
—— M	81	20	—— k	90	00
—— f1	135	16	—— l	100	20
—— f2	121	45	—— g1	107	5
—— e1	114	30	—— g2	83	2

The dark-colored varieties, which contain most iron, frequently act on the magnet. B B, it loses its transparency, but does not fuse, except when lithia is in combination, in which case it melts with facility, and at the moment of fusion tinges the flame of a delicate red hue. The variety lepidolite from Utön, according to Berzelius, in the matrass, gives off water, which if the heat be pushed to redness, is sensibly loaded with fluoric acid, yellows Brazil wood paper, and dulls the glass here and there by the silica it deposits on its surface.

	Broddbo.	*Lepidolite.* Zinnwald.	Utön.	Kimito.
Silica	46·10	46·23	47·05	46·36
Potash	0·00	4·90	9·60	9·22
Alumina	31·16	14·14	37·02	36·80
Peroxide of iron	8·65	17·97	3·02	4·53
Oxide of manganese	1·40	4·57	0·00	5·50
Fluoric acid	1·12	8·53	0·56	0·76
Lithia	0·00	4·21	0·00	0·00
Water	0·87	0·83	1·39	1·04
	97·64 Rose.	101·38 Gmelin.*	98·64 Rose.	98·21 Rose.

	Lepidolite. Paris, Me.?	*Green Mica,* Brunswick, Me.	Orange County, N. Y.	*Lepidolite.* Moravia.
Silica	47·99	64·44	49·38	50·35
Alumina	23·75	28·84	23·68	28·30
Protoxide of iron	0·00	4·42	7·31	0·00
Lime	0·00	0·00	6·13	0·00
Oxide of manganese	7·06	0·00	0·00	1·23
Potash	14·73	0·00	15·29	9·00
Lithia	3·16	0·00	0·00	4·49
Fluoric acid	0·00	0·00	0·00	5·20
Water	3·50	1·00	0·00	0·00
	100·19 Thomson.	98·70 Thomson.	101·79 Thomson.	98·61 Turner.

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* The recent analysis of lepidolite from Siberia, by M. Rosales, has shown the presence of soda as well as potash and lithia, and also nearly one and a half per cent. of chlorine. The alkalies are assumed to be isomorphous in mica, mutually replacing each other, and H. Rose believes that soda has been overlooked in the earlier analyses and included with the lithia, which last exists in a much smaller proportion than has usually been stated. (See Poggendorf's Annalen, 1843, No. 1.) [AM. ED.]

From the mean of the three analyses of common mica by Rose, Dr. Thomson gives this formula: $15AlS+1\frac{1}{2}KS^3+\underset{\cdot}{F}S^3$. But his own analysis of a specimen from Orange County, N. Y., would seem to show that we have not attained any degree of certainty in regard to the true atomic constitution of this species; and, as in the case of the former species, further investigation seems desirable.

1. Rubellane. Rubellon Aster-Mica. — ***Breithaupt.*** Supposed by some to be mica altered by heat. It contains potash and soda 10, silica 45, alumina 10, oxide of iron 20, lime 10, volatile matter 5. — ***Klaproth.*** Specific gravity 2·5 — 2·7. Hardness rather below 3·0. In thin laminæ of a reddish brown color, which are not flexible. Lustre pearly. Exfoliates in the flame of a taper. It occurs with mica and augite at Schima in the Mittelgebirge, Bohemia.

2. Lepidolite. Lepidolith. — ***Werner.*** The analysis of this variety by several chemists is given on the preceding page. It consists, mechanically, of an assemblage of small flexible scales which are translucent and sometimes hexagonal; and usually of a peach lossom color, appearing very beautiful when wetted. Other characters included in the general description of the species.

The species mica is an essential ingredient of many rocks, especially the oldest primitive, as granite, gneiss, mica-slate, &c.; and is often found filling up their fissures, or crystallized in the cavities of the veins which traverse them. It also occurs in sandstones and schistes. The best known localities of this mica are Siberia and America, St. Gothard in Switzerland, Pargas in Finland, Arendal in Norway, Finbo and Broddbo in Sweden, Zinnwald in Bohemia, Hörlberg in Bavaria, Aberdeenshire, and Cornwall. Variety lipidolite occurs near Rozena in Moravia, at Utö in Sweden; also at Pevru in Siberia. At the first named locality it is penetrated by rubellite.

According to Haüy, Muscovy glass, which occurs in plates of a yard or more in diameter, in veins of granite and micaceous schiste, in some parts of Russia, may be divided into laminæ no thicker than $\frac{1}{300000}$th part of an inch. It is used for enclosing objects for the solar microscope, and instead of glass in the Russian ships of war, as less liable to be broken by the concussion of the air during the discharge of heavy artillery.

In the United States there are numerous and extensive localities of this species, some of them affording specimens of gigantic size. Sheets more than two feet in length are not uncommon in the coarse granite of Ackworth, N. H.; and folia of nearly equal dimensions have been taken from the repositories of rubellite and green tourmaline at Paris, Me., where also is found abundantly the lepidolite variety. These folia are not unfrequently penetrated by compressed or flattened crystals of green tourmaline, which are sometimes disposed in a radiating form. Munroe, N. Y., has furnished crystals of large size, having a deep greenish-black color, and smaller but very perfect crystals are common in the limestone of Orange county, and accompanying the chrysoberyls, near Saratoga, of the same state. In Sussex County, N. J., crystallized mica is very generally disseminated through the white crystallized and granular limestone that contains the other well known minerals of that region; the finest forms are the brownish-red perfect, oblique, rhombic prisms that occur along with sapphire and spinelle, at Newton, N. J. In Massachusetts, at the beryl locality, Royalston, very perfect individuals in the same form, but replaced on their acute lateral edges, are imbedded in a greyish granular quartz. A beautiful rose-red, or violet colored variety, is found at Goshen and Chesterfield, accompanying rubellite and green tourmaline, but is not crystallized. In Maine, at Brunswick, near the college, a beautiful green variety is quite abundant, and at Bowdoinham, a rare form of the species *(mica filamenteux, of Haüy)* is met with in granite, and is in fibres as delicate as those of amianthus. An extremely brilliant silver colored mica has been brought from Edwards, St. Lawrence county, N. Y. The surfaces of many of the tables are curved and undulated. A green variety in irregular scales, but of extreme beauty, and which can scarcely be distinguished by the eye from uran-mica, is found in the neighborhood of Baltimore, Md. A similar variety, but of paler color, has also been met with near Philadelphia, Penn.

MARGARITE.*

Rhombohedral Pearl Mica, M. Rhomboidal Pearl Mica, J. Perl-Glimmer, L. Mica margarina, D.

Contains silica 37·00, alumina 40·50, oxide of iron 4·50, lime 8·96, soda 1·24, water 1·00 — according to Dumenil; making a loss of 6.80, and rendering a new analysis desirable.

Sp. Gr. 3·0 — 3·1. H = 3·5 — 4·5.

It occurs in thin crystalline laminæ, which intersect each other in every direction, and in thin hexahedral plates which cleave very readily parallel with their bases, and indistinctly parallel with their sides; indicating an hexagonal prism for the primary. Color pale pearl-grey passing into a reddish- and yellowish-white; translucent; lustre pearly on the terminal faces, vitreous on the others; streak colorless; rather brittle.

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* Margarite, from its peculiar pearly lustre.

Pearl mica is distinguished from the foregoing species by its superior hardness and specific gravity. It is peculiar to primitive rocks, being mixed with and engaged in foliated chlorite at Sterzing in the Tyrol.

LEUCITE.*

Leuzit, W. Amphigène, H. Trapezoidal Zeolite or Leucite, J. Trapezoidal Kouphone Spar, M. Vulcanus trapezohedrus, D.

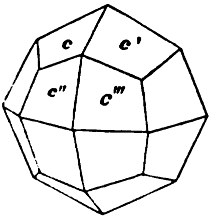
Combination of potash, silica, and alumina.

	Vesuvius.	Vesuvius.	
Potash	21·35	21·15	21·40
Silica	53·75	56·10	58·70
Alumina	24·63	23·10	19·95
	99.73 Klaproth.	100·35 Arfwedson.	100·05 Arfwedson.

The mean of these three analyses determines the atomic constitution of the mineral thus: $3AlS^2+KS^2$.

Sp. Gr. 2·48 — 2·5. H. = 5·5 — 6·0.

Leucite occurs in crystals whose planes are twenty-four equal and similar trapeziums, apparently with joints parallel to the rhombic dodecahedron and the cube; the latter of which, being the most simple of the two, has been adopted as the primary form. Leucite is generally of a dirty-white or grey-color, seldom reddish-white, and is occasionally somewhat translucent; its fracture is imperfectly conchoidal, with a vitreous lustre. Under the B B *per se* it is infusible, even in powder; with borax, fuses slowly into a diaphanous glass; and, with soda, effervesces and forms a transparent blebby glass. Is decomposed by muriatic acid without forming a jelly; the silica separating in the form of fine powder.



c on c′ . . . . 131° 48′ 16″ H.

c on c″ or c′ on c″ . . . 146 26 33.

The manner in which this crystal is derived from the cube will be apparent on consulting the crystalline forms of Analcime.

In the vicinity of Rome, at Borghetto some miles to the north, and at Albano and Frescati to the south, some of the older lavas are so thickly studded with this mineral as to appear almost entirely composed of it. Around Vesuvius it occurs in large well-pronounced crystals of the above form; and near Andernach on the Rhine it is equally abundant, though in less remarkable individuals.

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* Leucite signifies a white substance; Amphigène, of a double origin, in allusion to its being found both in the earlier rocks and in volcanic matter.

This mineral is peculiar in the history of chemical discovery, from being the first in which Klaproth observed the presence of potash.

PHILLIPSITE.

Lime-Harmotome, *Connell.* Staurotypous Kouphone Spar, M. Vulcanus Phillipsianus, D.

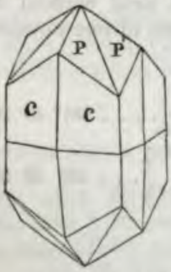
The analysis of four specimens of this mineral, has given the following results:

	Annerode.	Marburg.	Marburg.	Cassel.
Silica	53·07	48·51	48·02	48·22
Alumina	21·31	21·76	22·60	23·33
Barytes	0·39	0·00	0·00	0·00
Lime	6·67	6·26	6·56	7·22
Potash	0·00	6·33	7·50	3·89
Protoxide of iron	0·56	0·29	0·18	0·00
Water	17·09	17·23	16·75	17·55
	99·09 Wernekinck.	100·38 } Gmelin and Hessel.	100·16 } Gmelin and Hessel.	100·21*

The mean of the three first analyses gives the following formula, which conforms to the more recent results of Köhler :†
$4\text{AlS}^2+(\frac{2}{3}\text{Cal}+\frac{1}{3}\text{K})\text{S}^2+6\text{Aq}$.

Sp. Gr. 2·0 — H. = 4·5.

It has been observed only in macles resembling the following figure. The primary form is supposed to be a Right rectangular prism, thus agreeing with Barytes harmotome.



c on c . . . . 177° 28′

In white translucent or opake crystals, having much the aspect of Harmotome; cleavage imperfect. It occurs with gmelinite in the island Magee, county Antrim, in minute flesh-red colored crystals, coating cavities of amygdaloid; in large translucent crystals in the same description of rock, at the Giant's Causeway in Ireland; forming groups or sheaf-shaped aggregations at Capo di Bove near Rome; at Aci Reale on the eastern coast of Sicily; at Marburg in Hessia; at Lowenstein in Silesia; and among the lavas of Vesuvius.—*Allan's Manual.* This species was formerly united with Harmotome, but is now made distinct on the authority of Levy, who gave it the name it bears in compliment to the author of this work. It differs chemically from Harmotome in containing lime and potash, instead of barytes, and also in some of its other characters. The same name, in honor of R. Phillips, Esq., has been given to a very different mineral under the metalliferous class, which see.

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* Köhler in Poggendorff's Annalen, xxxvi., p. 562.

† Ibid.

APOPHYLLITE.*

Fishaugenstein, Albin, W. Apophyllite, H. Ichthyophthalmite. Pyramidal Zeolite, J. Pyramidal Kouphone Spar, M. Tesselite, and Oxahverite, *Brewster*. Vulcanus quadratus, D.

Combination of potash, silica, lime, and water.

	Utön.	Faroe. Tesselite.	Fassa.	Karasrat in Greenland.	Utön.
Potash	5·26	5·31	5·13	5·31	5·88
Silica	52·90	51·76	51·86	51·86	51·00
Lime	25·20	22·73	25·20	25·20	26·23
Water	16·00	16·20	16·04	16·90	16·50
Fluo silicate of lime	0·00	3·53	0·00	0·00	0·00
	99·36 Berz.	99·53 Berz.	98·43 Strom.	99·27 Strom.	99·11 Thom.

The analyses very nearly agree with each other proving the purity of the specimens, and from the mean composition results the following formula, as given by Thomson, $7\mathrm{CalS}^3+\mathrm{K}$ $\mathrm{S}+15\mathrm{Aq}$.

Sp. Gr. 2·3—2·5. H.=4·5—5·0.

Apophyllite occurs in the form of its primary crystal, a Right square prism, whose solid angles are sometimes replaced by triangular planes, which, by a deeper replacement, assume the form of rhombic planes. The structure is lamellar; cleavage highly perfect parallel to all the planes of its primary form, but most readily perpendicular to its axis; fracture uneven; color white or greyish, sometimes with a green or reddish tinge; transparent, translucent, or opake; the lateral planes of the prism have a shining lustre; the terminal are pearly. It becomes feebly electric by friction; B B, exfoliates, intumesces, and ultimately fuses into a white blebby glass; with borax it melts readily into a transparent globule; in nitric acid it separates into flakes, and when reduced to powder becomes gelatinous and translucent.

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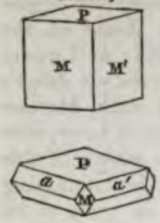
* Apophyllite, probably from its exfoliating B B.

Primary.



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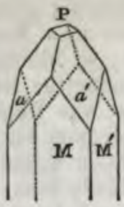

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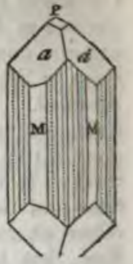

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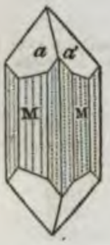

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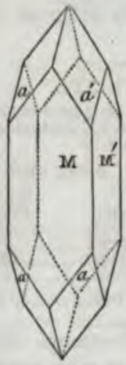

P on M or M′	90° 00′
M on M′	90 00
P on a or a'	120 5
M on a or M′ on a'	128 20
a on a'	104 18

The most splendid crystallized varieties of apophyllite occur coating the cavities of amygdaloid, associated with calcedony, stilbite, chabasie, &c., in Greenland, Iceland, the Faroe Islands, and at Poonah in Hindustan. The peculiar pearly lustre of the crystals is one of the most decided characters of the species, and has obtained for it the denomination of Ichthyophthalmite, or *fish-eye* stone, from the Greek. At Andreasberg it is found in silver veins traversing grauwacke-slate; in the Bannat associated with wollastonite; and at Oberstein occupying the cavities of agate balls. Foliated apophyllite occurs in the iron mine of Utön in Sweden, and with analcime in trap at the Seisser Alp, Tyrol; at the former almost transparent, at the latter white and opake. Fine crystals of the common form (*mésotype époinité* of Haüy) have recently been brought from New Holland, attached to masses of amygdaloid. The edges of the prisms, as well as the angles of the summits, are often deeply replaced by two or more planes, imparting a cylindrical form to the crystals, as shown by the figures 2 and 3.

Apophyllite is a rare mineral in the United States. Four localities are given in Robinson's catalogue, but the specimens possess scarcely any interest. It was found at Point Marmoase, on Lake Superior, Canada, by Dr. Bigsby, in amygdaloid, and under a secondary form not before noticed; having the appearance of an elongated octahedron with the terminal edges emarginated, and the angles of the base truncated. (*Troost, Jour. Acad. Nat. Sci.*, vol. v., p. 52.) In Nova Scotia it accompanies the other minerals of this class, and is presented under its most interesting forms in the amygdaloidal cliffs between Capes Split and Blomidon. The commonest form is that of the perfect Right square prism, with *no* replacements. Very frequently all the solid angles are replaced by single planes, and rarely by three planes. Occasional examples of low tabular crystals, similar to the form represented on the opposite page, are implanted upon the surfaces of yellow stilbite. These are perfectly transparent, and of extreme brilliancy, occasionally presenting a delicate tinge of green or red.

The variety termed *oxahverite* by Brewster, from the Oxahver Springs in Iceland, is of a pale-green color, indistinctly crystallized, somewhat translucent, and disposed on fossilized wood. Werner's *albin* rarely presents the terminal faces P; it is white and opake, and occurs associated with natrolite, near Aussig in Bohemia.

The *Tesselite* of Brewster is that variety particularly accompanying chabasie and mesole, from Nalsoe in the Faroe Islands, which exhibits, upon optical examination, a mosaic-like or tesselated structure.

HERSCHELLITE.*

Spatum Herschellianum, D.

The constituents of this mineral, according to the trials of Dr. Wollaston, are silica, alumina, and potash; but a complete analysis is yet required. It occurs crystallized in triangular dodecahedrons, the summits of which are deeply replaced; and in regular six-sided prisms, whose lateral faces are streaked horizontally. Levy considers the hexahedral prism to be its primary form. Color white. Translucent or opake. Fracture conchoidal. Cleavage easily obtained parallel to the base of the prism.

Herschellite occurs associated with Phillipsite in the cavities of trap, at Aci Reale, near Catania in Sicily. The individuals are sometimes isolated, but generally very closely aggregated, in a manner analogous to that which prehnite frequently presents.

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* Levy, Annals of Philosophy (Second Series), x., 361.

WEISSITE.*

Count Wachtmeister. (*Poggendorf's Annalen*, xiv., 190.)

Contains potash 4·10, soda 0·68, silica 53·69, alumina 21·78, magnesia 8·99, protoxide of iron 1·43, protoxide of manganese 0·63, oxide of zinc 0·30, water with traces of ammonia 3·20.—*Wächtmeister.* Formula: $2AlS^2+1(\frac{3}{11}Mg+\frac{2}{11}K+\frac{1}{11}\underline{F})S^2+\frac{1}{2}Aq$. By Beudant the water is not regarded as a chemical constituent. Sp. Gr. 2·80.

In oblique rhombic prisms, of an ash-grey or brownish color; translucent, and presenting only feeble traces of cleavage; lustre pearly or waxy; fracture even or coarse granular; scratches glass, but is scratched by steel; B B, in the matrass, it becomes brown, and yields water slightly acidulous; on charcoal it whitens, fuses on the edges, and becomes surrounded with an areola of zinc fumes; with borax it is slowly soluble into a colorless glass; also with salt of phosphorus, leaving a silica skeleton; with soda it melts into an opake scoria, and on platina foil exhibits the green color indicative of manganese.

Its locality is the copper mine of Eric Matts at Fahlun in Sweden, where it occurs in chloritic talc.

PEARLSTONE.

Perlstein, W. Lave Vitreuse Perlé, W.

Contains, by the analysis of Thomson, silica 70·44, alumina 11·6, peroxide of iron 4·38, lime 3·00, potash 5·20, water 4·28. Formula: $6AlS^5+SF^4+CalS^4+KS^4+4Aq$. Sp. Gr. 2·34.

Pearlstone occurs in large, coarse angular masses composed of smaller round concretions, which consist of very thin lamellæ. Surface smooth and shining, with a lustre resembling that of pearl.† Color grey, brown, red, or blackish; is fragile; translucent on the edges, and scarcely hard enough to scratch glass. It almost always gives out an argillaceous odor when breathed on; and B B, melts into a whitish frothy glass.

At Tokay and elsewhere in Hungary, it is found enclosing round masses of black vitreous obsidian, and is intermixed with the debris of granite, gneiss, and porphyry, and alternating in beds with the latter. It also occurs at Cap de Gat in Spain, of a green or bluish color; in Iceland, &c.

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* Named by Trollé Wächtmeister, in compliment to Professor Weiss of Berlin.

† Whence Pearlstone.

GIESECKITE.[*]

Giesockite. (*Prof. Jameson's Manual*, p. 323.) Giseckite, *Stromeyer*.

Combination of potash, silica, and alumina, with admixtures of magnesia and the oxides of iron and manganese.

Sp. Gr. 2·78 — 2·85.

Analysis by Stromeyer: potash 6·2, silica 46·27, alumina 33·82, magnesia 1·2, oxide of iron 3·35, oxide of manganese 1·15, water 4·8. This mineral occurs in regular six-sided prisms, externally of a brownish tinge, internally greenish and blackish-green intermixed. It possesses no regular structure, but on the contrary, being granular, with a waxy lustre, it has rather the appearance of a pseudomorphous steatitic mineral than of a crystalline substance. The crystal is opake, but small fragments are translucent; it yields to the knife, affording a white powder, but scratches common glass, on which the white powder of the mineral is left. B B, it is extremely refractory, fusing only on the edges after a long-continued exposure; and becoming at the same time magnetic. It effervesces slightly with nitric acid.

It was brought by Sir C. Giesècké from Akulliarasiarsuk in Greenland, where it occurs imbedded in compact felspar.

As there are some doubts in regard to the specific nature of this mineral, the formula is not given. There is reason to suppose that it may be an altered variety of pinite.

PINITE.

Pinit, W. Pinite, H. Micarelle, *Kirwan*. Stylus hexagonus, D.

Combination of potash, silica, and alumina, with admixture of soda, magnesia, and the oxides of iron and manganese.

	Auvergne.
Potash	7·89
Soda	0·59
Silica	55·96
Alumina	25·48
Oxide of iron	5·51
Manganese	3·76
	99·19 Gmelin.

Formula: $8\frac{1}{2}AlS^2+KS^2+2(\frac{9}{20}F+\frac{11}{20}Mg)S+Aq.$—*Thomson.*

Sp. Gr. 2·78 — 2·8. H. = 2·0 — 2·5.

The pinite occurs in six-sided or twelve-sided prisms, of which the lateral, and more rarely the terminal edges, are sometimes replaced, as in the following figure; but it does not appear generally to possess any regular structure; one crystal from the Puy de Dome yielded to mechanical division parallel to the terminal planes of the six-sided prism, which is considered to be the primary crystal. It has a brown, blackish-brown, or grey color; is opake, and almost devoid of lustre, being often somewhat ochreous externally. It yields to the knife easily, and is not affected by acids. B B, on charcoal, it whitens, and fuses on the edges into a white blebby glass, but does not melt; the most ferruginous varieties fuse more readily into a black glass. With borax it yields, after a continued blast, a transparent globule.

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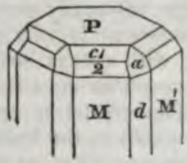
[*] In honor of the late Sir C. Giesècké.



M on M	120°	*c. g.*
P on M or M′ . . .	90	"
—— *c* 1	150	"
—— 2	131	"
—— *a*	120	"
M or M′ on *d* . . .	150	"

It was first discovered in granite, near Schneeberg in Saxony, in the mine called Pini, whence it was named by Werner. It has since been found in the Puy de Dome in France, in a decomposed porphyritic felspar; at Arendal in Norway, in mica; imbedded in the granite of St. Michael's Mount, Cornwall; and in Aberdeenshire.

In the United States, at Haddam, Ct., crystals several inches long, and considerably regular in form, are found in micaceous rock, and in rolled masses of granite. Crystals of a greenish color have been found imbedded in granite on George Hill, Lancaster, Mass.

PYRARGILLITE.

Nordenskiold. (*Berzelius' Jahr-Bericht*, 1834, p. 174.) Hydrolus pyrosmicus, D.

Contains Potash.......	1·05
Soda.........	1·83
Silica........	43·93
Alumina.....	28·93
Oxide of iron	5·30
Magnesia....	2·90
Water.......	15·47
	97·41

Sp. Gr. 2·50. H. = 3·5.

Occurs massive; assuming, though rarely, a form analogous to the four-sided prism with bevelled edges; frequently traversed by chlorite. Color partly black, and in that case shining; partly bluish, and then devoid of lustre. Is entirely soluble in nitric or muriatic acid. Emits an argillaceous odor when heated.*

It occurs in granite near Helsingfors in Finland.

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* Named Pyrargillite by Nordenskiöld, in allusion to this property.

BYTOWNITE.[*]

Dr. Thomson. (Outlines, &c., p. 372.)

The mineral to which Dr. Thomson has given this name, occurs in the neighborhood of Bytown, Upper Canada. It is composed, according to his analysis, as follows:

Silica	47·40
Alumina	29·60
Lime	9·32
Peroxide of iron	3·04
Magnesia	0·40
Soda	7·60
Water	1·96
	99·68

The atomic quantities indicated by these results are very nearly 15 atoms silicate of alumina, 3 atoms bisilicate of lime and magnesia, 2 atoms bisilicate of soda, 1 atom bisilicate of iron. The formula, admitting the bisilicates of soda and iron to have been previously united, is $5AlS+(\frac{11}{12}Cal+\frac{1}{12}Mg)S^2+(\frac{2}{5}N+\frac{1}{3}F)S^2$.

Sp. Gr. 2·801. H. = 6.

Color light greenish-blue; massive; texture granular; fracture splintery, with some foliated portions like little crystals; translucent; lustre vitreous, shining: B B, it becomes friable and white, but does not fuse; with carbonate of soda effervesces, but dissolves very slowly into an opake white globule; with borax fuses into a transparent colorless glass, leaving a silica skeleton.

COUZERANITE.

Dufrénoy. (Ann. de Chimie et de Phys., xxxviii., 280.)

This mineral was first noticed by the celebrated geologist, M. Charpentier, in his valuable work on the geological constitution of the Pyrenees. As he met with it principally in that part of the chain formerly known as Couzeran, he has called it couzeranite; but he did little more than mention its existence; and we are now indebted to M. Dufrénoy for a full description of its characters and its chemical analysis. It contains, according to the mean of two analyses,

Silica	52·37
Alumina	24·02
Lime	11·85
Magnesia	1·40
Potash	5·52
Soda	3·96
	99·12

The silica may be associated with its bases in different ways; but it is the simplest view of the case, as Dufrénoy observes, to suppose that this substance forms a silicate with alumina, a bisilicate with the alkalies, and a trisilicate with the alkaline earths, and thus conducts to this formula: $6AlS+(K,N)S^2+2(Cal,Mg)S^3$.

---

[*] Named from Bytown, in Upper Canada, where it has been found.

Sp. Gr. 2 69. H. about 6·5.

Color usually perfectly black; sometimes deep indigo-blue; rarely light grey; opake; the lustre rather brilliant, and both vitreous and resinous. Fracture conchoidal; structure slightly lamellar, parallel with the shorter diagonal, in which direction it is cleavable. B B, it fuses into a white enamel, pretty much like felspar; with biphosphate of soda it fuses into a milky bead; is not affected by acids; primary form an oblique rhombic prism, the faces of which, M on M, incline to each other at an angle of about 96°, the inclination of P on M being 92° to 93°. The crystals are frequently replaced on their obtuse edges by planes which incline equally on the two faces of the prism, making with each an angle of about 130°, but are rarely terminated; faces striated longitudinally.

This mineral bears considerable resemblance to pyroxene, but its fracture is very different, as is also its behaviour B B, and its chemical composition, which together must prevent it from being confounded with that mineral, or with felspar. The specimens analyzed were black, and it will be observed that the analysis gives no evidence of what the coloring matter consists. M. Dufrénoy supposes it to be owing to the presence of a small portion of carbon, which imparts the same color to the transition limestone in which the mineral is found. It exists in the greatest quantities in the valleys of the Seix, which border upon Saint Girons.*

FELSPAR.†

Feldspath, W. H. Prismatic Feld-spar, M. J. Spatum orthotomum, D.

Combination of potash, soda, silica, and alumina.

	Adularia.	*Murchisonite.*	Carlsbad. *Opake, white.*
Potash	14·0	14·8	11·50
Silica	64·0	68·6	64·50
Alumina	20·0	16·6	19·75
Lime	2·0	0·0	a trace.
Oxide of iron	0·0	0·0	1·75
	100·0 Vauq.	100·0 R. Phillips.	97·50 Klaproth.

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* The very brief description of this mineral in the last edition of this work, scarcely did justice to a distinguished mineralogist; a fuller account has now been drawn from his original paper. [Am. Ed.]

† From the German Feldspath, field-spar; in allusion perhaps to its being found loose on the surface of some parts of the country.

	Iridescent. Frederickswärn.	*Green.* Siberia.	*Flesh-colored,* Lomnitz.	*Adularia,* St. Gothard.
Potash	12·2	13·0	12·00	16·95
Silica	63·0	62·8	66·75	64·20
Alumina	20·0	17·0	17·50	18·40
Lime	a trace	3·0	1·25	0·00
Oxide of iron	1·3	1·0	0·75	0·00
	96·5 Klaproth.	96·8 Vauq.	98·25 Rose.	99·55 Berthier.

These analyses differ considerably in their quantitative results, but if we take the last, which was performed on a very pure adularia — the ultimate perfection of the species — we obtain for the constitution of the mineral, three atoms tersilicate of alumina, one atom tersilicate of potash. Formula: $3AlS^3+KS^3$.*

Sp. Gr. 2·5 — 2·6. H. = 6·0.

Few minerals vary so much in appearance, or present more numerous and complicated crystalline forms, than felspar. It has hence been distinguished into several varieties, the transition from the one to the other of which, is however so gradual, that in describing them these distinctions are not very easily made.

1. ADULARIA. Moon-stone.† Adular, W. Feldspath nacré, H. Orthoklas, *Breithaupt.* This variety of felspar is semi-transparent, or translucent; it is greyish, greenish-white, or milk-white, and is frequently iridescent. It occurs both massive and crystallized; the forms of the crystals of Adularia, which consist of two, three, or four individuals, placed either parallel or obliquely to one another, being extremely complicated. Cleavage highly perfect, and easily obtained parallel to P of the following figure. Lustre vitreous, inclining to pearly on the perfect faces of cleavage. When splendent, with a pearly lustre, and exhibiting, especially if cut and polished, a bluish- or greenish-white chatoyant reflection of light, it is termed *Moon-stone.* The *Sun-stone* is the same, having exceedingly minute scales of mica interspersed throughout its mass, which being disposed in parallel position, reflect a pinchbeck-brown tint. In these, as well as in the Norwegian Labrador (as it is called), from Frederickswärn, this opalescent appearance is only in one direction, namely, in that which bevels the edge between T and T somewhat obliquely. The variety from this locality is a grey felspar, distinct from the species labradorite which follows, but presenting, like it, some very beautiful hues. B B, upon charcoal, it becomes glassy,

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* From the recent examination of M. Abich, confirmed by Prof. G. Rose, it appears that the potash in all felspars is accompanied by more or less soda; adularia containing the least. (Poggendorf's Annalen, L. 125, 341, and L 11, 465.) [AM. ED.]

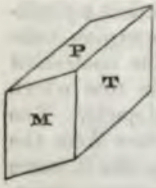
† Adularia, from Mount Adula, on which it is supposed first to have been found, Moon-stone, from the brilliant light reflected by it.

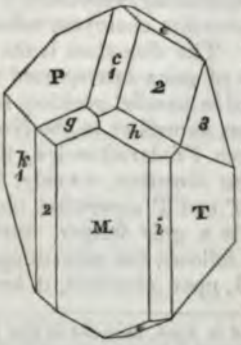
semi-transparent, and white, but fuses only on the edges; with borax it dissolves slowly into a clear globule, and is not acted upon by acids.

It occurs in veins and cavities in granite, gneiss, clay-slate, and limestone, with quartz, amianthus, &c. at St. Gothard, where crystals, sometimes even a foot in thickness, have occurred; in Britain in the granite of Arran; in veins passing through schiste at Tintagell on the northern coast of Cornwall, &c. The finest specimens of moon-stone occur imbedded in granite in Ceylon. Considerable veins of sun-stone have recently been found on the Selenga in Siberia, and masses taken from them have been fashioned into vases two feet high. Great value is attached to these specimens, as even small ring-stones are very highly esteemed.

2. **Common Felspar** is mostly opake, or translucent only on the edges: the lustre on the lamellar fragments is vitreous or pearly; the cross fracture uneven and glimmering. It presents white, yellow, blue, green, or red colors; and is either granular or massive, disseminated or crystallized. The crystals yield to cleavage parallel to the planes P M and T of the following figures, affording as primary form a Doubly oblique prism, which presents in one direction four angles of 90°; in another, four alternately of 59° 25′ and 120° 35′; in another, four alternately of 67° 15′ and 112° 45′; the latter are obtained with great difficulty, the former with more ease, and the natural joints are generally visible in a direction parallel to the plane P. On charcoal it is fusible with borax into a semi-transparent glass.

Primary Form.





M on T . .	120°	35′	00″	
P on M . .	90	00	00	
—— T . .	67	15	00	
—— *c* 1 . .	145	20	00	
—— *c* 2 . .	129	30	00	
—— *c* 3 . .	99	41	8	H.
—— *k* 1 . .	112	5	00	
M on *c* 1 . .	90	00	00	
—— *i* . . .	150	00	00	
—— *k* 1 . .	120	30	00	
—— *k* 2 . .	150	00	00	H.
—— *h* . . .	116	35	00	
T on *c* 2 . .	111	00	00	
—— *i* . . .	150	00	00	H.
—— *k* . . .	60	50	00	
c 1 on *c* 2 . .	164	42	00	
c 2 on *c* 3 . .	150	45	28	H.
c 1 on *h* . . .	149	10	00	
c 2 on *h* . . .	152	30	00	
k 1 on *k* 2 . .	150	00	00	H.

Common felspar is a very generally diffused mineral; it is an essential constituent of granite and gneiss, and also frequently occurs in these rocks in veins, and in micaceous and argillaceous schiste. It abounds in primitive and secondary traps, and in most lavas.*

The coarser kinds of felspar are also frequently macled, presenting some of the most remarkable hemitrope forms that occur in the mineral kingdom. At Carlsbad and Elbogen in Bohemia, twin crystals occur, exhibiting the union of two individuals which have been turned round to the extent of 180°, and attached to each other laterally. According to their points of junction, these are denominated *rights* and *lefts;* for in whatever position one of them is placed, its faces are never parallel or homologous to those of the other. At Carlsbad they occur from two to four inches in length, the rapid decomposition of the surrounding granite strewing the fields with them in vast quantities. They, as well as the varieties from Ekatherineburg in Siberia, and Warmbrunn in Silesia, are opake, have an earthy-brown color, and are extremely coarse and rough externally. The Land's End granite is also studded with similarly formed crystals, though on a smaller scale; and, what is remarkable, pseudo-crystals of tin have been found in Cornwall assuming precisely similar macles. Large well-defined opake crystals are brought from Elba, and Arendal in Norway. The twins from Baveno in Piedmont, and La Clayette in Auvergne, are well-known; as are the beautiful varieties accompanying beryl and topaz in the Mourne Mountains of Ireland. An occasionally crystallized variety of a beautiful apple-green color (*Amazon-stone*) is met with at the eastern base of the Ural Mountains, near the fortress of Troitzk; and the yellowish-grey and somewhat transparent kind, termed *Murchisonite* by Levy, is found near Dawlish in Devonshire, and in Arran; also in Cornwall, between Holloway Hill and Watcombe, and in the conglomerate of Heautree, near Exeter. Kersten has described crystals formed in a copper furnace, which in composition and form agree with felspar.

3. Ice-Spar.† Eis-spath, W. It occurs in white transparent or translucent flattish crystals, of which the primary form is a right oblique-angled prism, differing but little in its proportions from a right rhombic prism. It yields to cleavage parallel to all the primary planes — with difficulty parallel to

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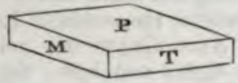
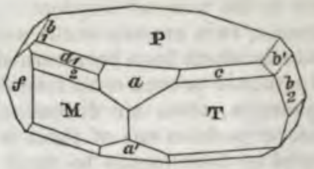
* From its decomposition the potash of soil is mainly derived. Supposing the soil to have been derived from granite, consisting of two fifths quartz, two fifths felspar, and one fifth mica, it may be shown that every acre of it, six inches deep, contains *thirty-six tons of potash.* (*Dr. S. L. Dana's Muck Manual.*)

† Ice-spar, from its possessing a considerable resemblance to ice, both externally and in brittleness.

T, more easily to P and M of the following figures. It possesses a shining lustre, and is very brittle. According to Berzelius, B B, on charcoal, it becomes vitreous, semi-transparent, and white, and fuses with difficulty on the edge into a blebby semi-transparent glass: with borax into a diaphanous glass.

Primary.





P on M or T . . .	90°	00′	P on *b* 2	120°	30′
M on T	129	40	—— *c*	134	38
—— *a*	127	45	—— *d* 1	116	35
T on *a*	128	15	M on *f*	150	00
P on *a*	318	5	T on *b* 2	112	20
P on *b* 1 . . . . . ,	125	25	M on *b* 2 over *f* .	110	49

It occurs at Mont Somma, near Naples, with nepheline, mica, meionite, and hornblende.

4. **Decomposed Felspar, Porcelain-Clay.** Porcellanerde, W. Feldspath decomposé, H. Porcelain-Clay, *Kirwan.* Sp. Gr. 2·216. It is commonly yellowish-, sometimes reddish-white; occurs massive, and disseminated in certain rocks; and is composed of small particles which possess but slight coherence. It adheres to the tongue, and is soft and meagre to the touch. It often includes crystals of felspar, of quartz, and of mica, and is evidently derived from the decomposition of granitic rocks: is infusible. A variety from Aue in Saxony yielded silica 52·0, alumina 37·0, and iron 6·33. The Saxon porcelain is made of clay from a bed in granite near Meissen; the Austrian from clay dug near Passau; that of Copenhagen from the produce of Bornholm, an island in the Baltic. The porcelain-clay of China is called *Kaolin.* In Britain, a large tract of this clay, which includes crystals of felspar, quartz, and mica, exists near St. Austle in Cornwall, on the south side of the granite range; it supplies the porcelain manufactories of Worcester.

In the United States, kaolin is found at Monkton, Vt., in an extensive bed beneath fragments of quartz, felspar, and graphic granite, from the decomposition of which it has been produced.*

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* The composition of kaolin is quite different from felspar, consisting of 55 per cent. of silica and 45 of alumina, rarely uniting either potash or soda, which seem to have been

It is white, and retains its color in the fire. According to Prof. Shepard, kaolin, either pure or mingled with decomposed albite, abounds in New Milford, Kent, and Cornwall, Ct.

GLASSY FELSPAR.

Ryacolite. Glassiger Feldspar, W.

Composed of silica, alumina, potash, and soda.

Vesuvius.		Mount D'Or.		Drakenfels.	
Silica	65·52	Silica	66·1	Silica	66·6
Alumina	19·65	Alumina	19·8	Alumina	18·5
Potash Soda	14·78	Magnesia	2·0	Magnesia	1·0
Lime	0·69	Potash	6·9	Potash	8·0
		Soda	3·7	Soda	4·0
	100·64 Rose.		98·5 Berthier.		98·1 Berthier.

The atoms of silica in this, as in the preceding species, are thrice as numerous as those of the bases; but in this we have both potash and soda, and the proportion of alkali to alumina is less. The formula, as deduced by Thomson from the mean of the three analyses, is: $4AlS^3+(\frac{5}{6}K+\frac{1}{6}N)S^3$.

Sp. Gr. 2·58. H. = 6·0.

Ryacolite, which has usually been described as a variety of common felspar, was first distinguished as a peculiar species by Rose. It is always crystallized in Doubly oblique rhombic prisms, the angles of which differ, however, from those of the individuals of adularia or common felspar, the inclination of M on T being nearly a degree greater. It appears also to differ from adularia (by the experiments of Mitscherlich) in its optical properties. The crystals are grey, greyish-white, or yellowish-white, and semi-transparent; they usually have the appearance of being cracked in various directions. Fracture imperfect conchoidal; lustre internally splendent and highly vitreous.

It occurs imbedded in trachyte in Bohemia; at Drackenfels, near Bonn, on the Rhine; in the lava of Vesuvius and of the Laucher Sea; in the trachytes of Hungary, and, imbedded in pitchstone, in the islands of Arran and Rum.

PETALITE.*

Petalite, Br. Berzelite. Prismatic Petalite, J. Prismatic Petaline Spar, M. Petalus rhombicus, D.

Combination of silica, alumina, and lithia.

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washed away in the disintegration of the rock. Indeed, Fuchs seems to regard it as derived from a peculiar mineral, resembling felspar physically, but of a different composition. But Brongniart has lately published (Berzelius's Jahres-Bericht) an essay on the formation of kaolin, in which he has given the results of thirteen analyses of this mineral, from various localities. He infers that it is the product of the decomposition of the felspar, effected by what he calls a hydro-electrical influence on the rock [AM. ED.]

[*] Petalite, from the Greek, signifying of perfectly lamellar structure (in one direction).

			Bolton, Mass.
Silica	79·21	74·17	52·00
Alumina	17·22	17·41	19·60
Lithia	5·76	5·16	Lithia & Soda 1·92
Lime	0·00	0·32	22·24
Carbonic acid	0·00	0·90	3·60
Water	0·00	2·17	3·60
	100·19 Arfwedson.	99·23 Gmelin.	100·00

Formula deduced from the second analysis: $2AlS^4 + LS^4$.

Sp. Gr. 2·44. H. = 6·0.

Color white, with frequently a reddish tinge; its structure is perfectly lamellar in one direction, and it admits of mechanical division with some difficulty parallel to the sides and both diagonals of a rectangular but not square prism, apparently with oblique summits. It is translucent, and has a glistening lustre, approaching to pearly on the perfect faces of cleavage; but is not affected by acids. When gently heated, it emits a blue phosphorescent light. Alone on charcoal, B B, it fuses on the edges with difficulty into a blebby semi-transparent glass; with borax into a diaphanous glass.

Petalite has hitherto been met with in Europe only at the iron mine of Utön, an island about thirty-five miles south-east of Stockholm, where it was first noticed by D'Andrada, accompanying lepidolite, tourmaline, spodumene, and quartz. The pink tinge which it occasionally presents, denotes a minute admixture of oxide of manganese.

In Upper Canada, on Lake Ontario, near York, this mineral was found by Dr. Bigsby.

In the United States at Bolton, Mass., it occurs in limestone, with scapolite, sphene, asbestus, &c. It was in this mineral, from Utön, that Arfwedson discovered lithia, the new alkali.

SPODUMENE.†

Prismatic Spodumene, J. Prismatic Triphane Spar, M. Spodumene, *D'Andrada.* Triphane, H. Augitus rhombicus, D.

Combination of silica, alumina, and lithia.

	Uton.	Uton.	Killiney.	Sterling, Mass.
Silica	66·40	63·29	63·31	80.80
Alumina	35·30	28·78	28·51	13·28
Lithia	8·85	5·63	5·66	3·00
Protoxide of iron	1·45	0·79	0 83	0·00
Lime	0·00	0·00	0·72	0·92
Protoxide of manganese	0·00	0·20	0·00	0·00
Soda	0·00	0·00	0·00	2·00
Moisture	0·45	0·77	0·36	0·00
	102·45 Arfw.	99·46 Strom.	99·73 Lehunt.	100·00

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* This was probably a mixed mineral, consisting of petalite, table spar and a portion of carbonate of lime. The specimen, however, was carefully selected.

† From σποδος, ashes; meaning that it assumes a form like ashes, B B.

‡ This, and the last analysis of petalite, above stated, were made in Dr. C. T. Jackson's Laboratory, and under his direction, by Mr. J. Chandler, Jr.

Formula from the second and third analyses, as given by Beudant and Thomson, $4AlS^2+LS^2$.

Sp. Gr. 3·0—3·2. H. = 6·5—7·0.

This mineral occurs massive; its structure is lamellar; lustre shining and slightly pearly; cross fracture fine-grained and uneven, with a glimmering lustre; color greyish or light-green; it is translucent, scratches glass, and is brittle. According to Brooke it cleaves parallel to the planes and both diagonals of a rhombic prism of 93° and 87°, and less perfect cleavage faces have been obtained, indicating an oblique base to the prism, and forming, with its obtuse edge, an angle of about 135°. Its primary is therefore an Oblique rhombic prism. It becomes colorless and opake when exposed to a red heat; B B, on charcoal, it intumesces, and fuses into an almost transparent glass.

It occurs in the iron mine of Utön, in Sweden, in a gangue of red felspar, quartz, and tourmaline; also in the Tyrol, near Sterzing; and, having a pale-green or yellowish tinge, in granite, with killinite, at Killiney near Dublin.

In the United States it is abundant at Goshen, Mass., in granite, and is associated with tourmaline and beryl: is also found at Chesterfield and Sterling, Mass. At the latter place, it occurs in large masses having a foliated structure, and is readily cleavable into rhomboidal prisms.

LATROBITE.

Latrobite, *Brooke* and *Gmelin.* Diploite, *Breithaupt.* Spatum roseum, D.

Occurs in crystalline masses, and in Oblique rhombic prisms of about 93° 30′ and 86° 30′. Color pale rose-red, or pink, resembling the color of lepidolite; and opake. Lustre vitreous. Cleavage in three directions, intersecting each other at angles of 98° 30′, 91°, and 93° 30′. Two analyses by Gmelin yielded

Potash	6·58	6·57
Silica	44·65	41·78
Alumina	36·81	32·83
Lime	8·29	9·79
Oxide of manganese	3·16	5·76
	100·49	96·73

Formula, as given by Thomson, from the first analysis, oxide of manganese not being essential: $5AlS+(\frac{2}{3}Cal+\frac{1}{3}K)S$.

B B, in the platina forceps, it fuses, intumesces into a white enamel, and with borax yields a globule which is pale amethyst-red in the oxidating flame, and colorless in the reducing one. With salt of phosphorus it fuses into a clear glass, containing a skeleton of silica.

Its only known locality is Amitok Island, near the coast of

Labrador, whence it was brought by the Rev. C. J. Latrobe, who found it associated with felspar, mica, and calcareous spar. It was first named and described by Brooke. *Annals of Phil. (2d series)*, v., 383.

AGALMATOLITE.

Bildstein, W. Figurestone or Agalmatolite, J. Talc Graphique, H. Steatite Pagodite, Bt. Ophitis figularis, D.

			China.
Contains	Potash	7·0	6·25
	Silica	56·0	54·50
	Alumina	29·0	34·00
	Lime	2·0	0·00
	Oxide of iron	1·0	0·75
	Water	5·0	4·00
		100·0 Vauquelin.	99·50 Klaproth.

From the mean of six analyses which nearly correspond with the last by Klaproth, Dr. Thomson states the constitution of the mineral thus: $13\text{Al}\text{S}+\text{KS}+4\text{Aq}$.

Sp. Gr. 2·8 — 2·85. Soft.

It occurs massive, and sometimes presents an imperfectly slaty structure; general color greenish, or yellowish-green, with veins of blue or brown; rarely also pink or mottled; translucent on the edges, unctuous to the touch, and generally yields to the pressure of the nail. B B on charcoal it whitens, and presents some slight marks of fusion; and with borax affords a colorless glass. It is partly soluble in sulphuric acid, leaving a siliceous residue.

Brongniart has given it the name of steatite pagodite, from its being always brought from China in the form of little grotesque figures[*] and chimney ornaments, but its different analyses distinguish it sufficiently from steatite, which always contains magnesia, but no potash. The agalmatolite is also found at Nagyag in Transylvania; in Norway; and at Glyder Bach, Caernarvonshire.

LEELITE.[†]

Dr. Clarke. (Annals of Philosophy, xi., 367.)

Leelite, the *helleflinta* of the Swedes, is found compact and massive, of a deep flesh-red color, at Gryphytta in Westmania, in Sweden. It possesses a peculiarly wax-like texture, and about the same lustre and translucency as horn. The fracture resembles that of flint.

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[*] Whence also the name Agalmatolite, from the Greek.

[†] In honor of J. F. Lee, LL. D., of St. John's College, Cambridge.

Silica	75·00	Silica	81·90
Alumina	22·00	Alumina	6·55
Manganese	2·50	Protoxide of iron	6·42
Water	0.50	Potash	8·88
	100·00 Clarke.		100·76 Thomson.

Sp. Gr. 2·71. H. = 6·25.

The mineral was first noticed by Dr. Clarke of Cambridge, by whom it was analyzed. It has since been analyzed by Dr. Thomson. The results, as stated, are so discordant that it seems hardly possible that the same mineral could have been employed by both; yet both have given the same description of its general characters. It is regarded by some as a variety of felspar. It has not been found crystallized.

KILLINITE.

Contains	Potash	6·06	6·72
	Silica	47·92	49·08
	Alumina	31·04	30·60
	Oxide of iron	2·32	2·27
	Oxide of manganese	1·25	1·08
	Lime	0·72	0·68
	Water	10 00	10·00
		99·97 Blythe.	100·43 Lehunt.

The formula from the mean of these two analyses, as given by Dr. Thomson, is: $9\text{AlS}^{1\frac{1}{4}}+(\frac{1}{3}\text{K}+\frac{2}{3}\text{F})\text{S}^2+4\text{Aq}$.

Sp. Gr. 2·65—2·75. H. = 4·0.

This mineral is of a light green, sometimes tinged brown or yellow, the progress of decomposition resulting from exposure. It occurs massive, with the occasional appearance of prisms, rifted across, and irregularly disposed; one prism afforded, by the common goniometer, angles of 135° and 45°. The structure is lamellar, yielding to mechanical division parallel to the lateral planes of a rhombic prism of 135° and 45°, and its lesser diagonal, but not parallel to its terminal planes; its lustre is glimmering; the cross fracture is fine grained. It is translucent, yields to the knife, and is easily frangible. The coating arising from exposure, yields an argillaceous odor when breathed on. B B, it loses its color and becomes white, intumesces, and fuses into a white enamel.

This mineral was discovered by Dr. Taylor in granite veins, near the junction of mica-slate with granite, at Killiney[*] near Dublin. It is accompanied by spodumene, quartz, felspar, and garnet,—to the first of which it bears considerable resemblance.

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[*] Whence Killinite.

GLAUCOLITE.

Contains		
Potash	1·27	4·57
Soda	2·96	0·00
Silica	50·58	54·58
Alumina	27·60	29·77
Lime	10·27	11·08
Magnesia	3·73	0·00
	97·41 Bergmann.	100·00 Bergmann.

The formula, as given by Beudant from the last analysis, is, $3AlS^2+(Cal,K)S^2$.

Sp. Gr. 2·72—2·9. H.=5·0.

Occurs massive, presenting traces of cleavage parallel to the faces of a rhombic prism of 143° 30′ nearly (according to Brooke). Color lavender-blue, occasionally passing into green. Translucent on the edges; fracture splintery; lustre vitreous. B B, it whitens, and fuses only on the edges; but is soluble with effervescence in borax, or salt of phosphorus.

This mineral was first noticed near Lake Baikal in Siberia, imbedded in compact felspar and granular limestone; it has also been found with elaolite at Laurvig in Norway.

MESOTYPE.

Zeolith, W. Var. of Zeolite, J. Peritomous Kouphone Spar, M. Natrolite. Mesotype, H. Crockalite. Edelite. Vulcanus peritomus, D.

Combination of silica, soda, and water.

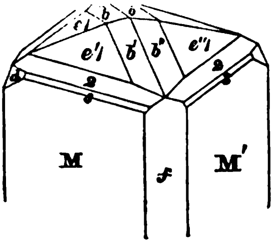
	Faroe.	Auvergne.	*Natrolite.* Hohentwiel.	Antrim.
Soda	17·0	16·76	16·02	14·93
Silica	49·0	48·04	48·00	47·56
Alumina	27·0	25·03	26·05	26·42
Water	9·5	9·65	9·03	10·44
Oxide of iron	0·0	0·00	0·00	0·58
	102·5 Smithson.	99·48 Thomson.	100·00 Gehlen.	101·33 Thomson.

Adopting these analyses, the composition of this mineral is thus expressed: $3AlS+NS+2Aq$

Sp. Gr. 2·24—2·5. H.=5·0—5·5.

This mineral occurs crystallized, fibrous, and pulverulent. The primary form is a Right rhombic prism, parallel to the lateral faces of which it is readily susceptible of cleavage; but no cleavage has been obtained parallel with the terminal planes, which are almost always obliterated by a pyramid. The faces M on M′ 91° 10′, by the measurement of Brooke, and also by Gehlen and Fuchs. Color white, yellow, or greyish, and transparent or translucent, with a vitreous lustre. It yields to the knife, but scratches calcareous spar.

It becomes electric by heat, the heated fragments exhibiting a dull blue phosphoric light. B B, on charcoal, it becomes opake, and then vitrifies without intumescence; with borax, fuses with difficulty into a transparent colorless glass; and is soluble in, and forms a thick jelly with, acids, even after exposure to heat of redness.



M on M′	91°	20′
M on e′1 or M′ on e″1	116	56
M on e′2	117	24
e′1 on e′2	179	32
e′1 on e″1	143	33
e1 on e′1	142	33
b′ on b″	146	23
e′2 on e″2	142	38

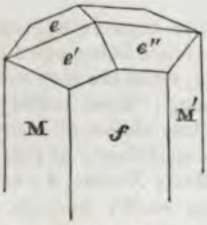
The *fibrous* variety consists of minute crystals aggregated in a radiating or stellular form; the centre being often compact enough to yield a splintery fracture, while the surrounding part is soft and apparently decomposing: these masses are sometimes globular. They frequently lose almost all traces of a fibrous structure, and break with the appearance of ivory.

The earthy or *pulverulent* variety (Mealy Zeolite, J.) occurs in soft, dull, friable masses, having an earthy fracture, and rough meagre feel. It is of a white, greyish, or reddish color.

The crystalline varieties of this beautiful mineral are principally found forming diverging groups, in the vesicular cavities of amygdaloid in the Faroe Islands. In the trap rocks of the Giant's Causeway, and some of the Hebrides, it likewise occurs in delicate acicular crystals; associated with analcime at Montecchio Maggiore in the Vicentine; in small silky-like diverging tufts coating cavities of lava in the more ancient portions of Vesuvius; radiated and mammillated at Hauenstein in Bohemia, and elsewhere on the continent.

In the United States extremely beautiful and delicate forms of stellated or radiated mesotype, have been discovered in the deep rail road excavation made through a portion of the trap ridge of Bergen County, N. J. Crystals radiating from a common centre form perfect spheres, the entire surfaces of which are studded over with brilliantly reflecting pyramids, usually colorless, and possessing a highly vitreous lustre. In Nova Scotia, the same delicate forms are also observed, but the individuals are usually of much greater magnitude. They often assume a radiated and interwoven structure, presenting, when broken, a centre which is pure white, compact, and has the appearance of ivory. Instead of the low pyramid, sometimes one replacement on a terminal edge covers the whole face of the prism, or obliterates the other three planes. The usually accompanying mineral is analcime, crystals of which are imbedded in the compact mesotype, and may be removed, leaving perfect impressions of their form.

Natrolite.[*] Natrolit, W. H. Vulcanus rhombicus, D. Prismatic Kouphone Spar, M. It occurs in mammillary masses, which, when broken, present a fibrous structure; the fibres are diverging, exhibit a pearly lustre, and are white, or of yellowish or reddish-brown colors, disposed in alternate zones around the centre; in the cavities or on the surface of these may sometimes be observed minute crystals of the same form and measurements as those of mesotype. Its specific gravity is 2·2. B B, it affords the same results as mesotype.



M on M′	91° 35′
— or M′ on *f*	135 35
— on *e*′ or M′ on *e*″	116 58
e′ on *e*″	143 35
e′ or *e*″ on *f*	109 18

Its principal locality is Hohentwiel in Suabia.

Natrolite has been by some classed as a distinct species, but is now more generally included under the present species, with which it agrees in composition, and offers the same crystallographical measurements, according to Brooke. The stellite of Dr. Thomson is evidently quite a different mineral from natrolite, and has been already described in the previous class.

THOMSONITE.[†]

Orthotomous Kouphone Spar, M. Thomsonite, *Brooke.* (*Annals of Philosophy*, xvi., 194.) *Thomson.* (*Ibid.*, p. 408.) Needle Zeolite (in part), W. Mesotype (in part), H. Vulcanus Thomsonianus, D.

Combination of silica, alumina, lime, soda, and water.

	Kilpatrick.	Dumbarton.
Soda	4·53	3·70
Silica	38·30	37·08
Alumina	30·20	33·02
Lime	13·54	10·75
Water	13·10	13·00
	99·67 Berzelius.	97·55 Thomson.

Formula, deduced from the last analysis: $3\mathrm{AlS}+\mathrm{CalS}+2\frac{1}{2}\mathrm{Aq}$. The alkali is not a constant ingredient, for in ten specimens examined by Dr. Thomson, none was found.

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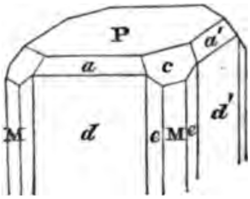
[*] Natrolite, from its containing natron.

[†] Thomsonite, in honor of Dr. Thomson, of Glasgow.

Sp. Gr. 2·35. H. about 5·0.

This mineral has much resemblance to mesotype or needlestone, from which, however, it differs materially in respect of cleavage and form. It occurs generally in masses having a columnar or radiated structure, in the occasional cavities of which indistinct crystals may be observed. Colorless and translucent, but small fragments are transparent. It possesses considerable lustre, approaching to pearly; and is brittle. Primary form, according to Brooke, a Right square prism; cleavage readily obtained parallel to its sides, affording, by the reflecting goniometer, 90° of one plane on the next; but it does not cleave parallel to the terminal planes of the prism. B B, it intumesces, or swells up like borax, and becomes snow-white and opake, but does not melt. When exposed to a red heat, it gives off water, becomes opake, white, and shining like enamel; the edges are rounded, but it does not altogether lose its shape. It usually communicates to the blowpipe flame the yellow color which indicates the presence of soda.



M on M	90° 0′[*]
P on M or M	90 0
M on *d*	135 0
d on *d*	90 18
P on *a*	134 36
— — *c*	125 0

It occurs, imbedded in trap with analcime and prehnite, at Lochwinnoch, and near Kilpatrick, a few miles from Glasgow, Scotland.

In the United States, the trap rocks of Bergen, N. J., have furnished many very beautiful specimens of what has been supposed to be a radiated and compact thomsonite, associated with several other minerals of the same class. But according to a very careful analysis of this mineral by A. A. Hayes, it has but little affinity with thomsonite in its chemical composition, as it is *anhydrous* and contains no *alumina*, but thirty-five per cent. of lime.[†]

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[*] Mr. Brooke now gives this angle at 90° 40′, and consequently regards the primary form as a Right rhombic prism.

[†] This most remarkable result has just been communicated to me by Mr. Hayes, to whom I gave a specimen of the mineral obtained by myself at the locality, for his examination. It is thus shown to be distinct from the stellite of Dr. Thomson, as well as from the mineral analyzed by Dr. Beck. It remains to be determined whether it is crystallographically distinct from Thomsonite. The analysis is thus stated: silica 55·96, lime 35·12, soda 6·75, potash 0·60, protoxide of manganese 0·61, alumina 0·08, hygrometric water 0·16. [Am. Ed.]

In Nova Scotia it is one of the common minerals of the trap rocks bordering the Bay of Fundy, occurring in globular masses of radiated interwoven crystals, interspersed with stilbite, apophyllite, and analcime. These masses are hollow, presenting internally very distinct colorless and transparent prisms in the primary form, and more than an inch in length, — replaced at their free extremities by low four-sided pyramids.

PERISTERITE.[*]

Dr. Thomson. (Lond., Edin., and Dub. Phil. Mag., 1843, xxii., 189.)

This mineral was found at Perth, Upper Canada, and was sent to Dr. Thomson under the name of iridescent felspar; but he observes that neither its characters nor its composition correspond with that appellation. His analysis gave, silica 72·35, alumina 7·60, potash 15·06, lime 1·35, magnesia 1·00, oxides of iron and manganese 1·25, moisture 0·50.

The silica is much greater than in felspar, and the alumina much less, while the proportion of potash is nearly the same. If we were to consider the lime and magnesia and the oxides of iron and manganese as accidental bodies united to silica in the same ratio as the alumina and the potash, the constitution of the mineral might be represented by $4(AlS^5)+3(KS^5)$. If the lime and magnesia be essential constituents, the formula will be $AlS^5+(\frac{6}{8}K+\frac{1}{8}Cal+\frac{1}{8}Mg)S^5$.

The specimens were amorphous masses, and had the appearance of having constituted part of a rock blasted by gunpowder.

It is light brownish-red, and exhibits a play of colors, chiefly blue, on the surface. It is translucent on the edges; the lustre is vitreous and the texture imperfectly foliated: its specific gravity is 2·568; its hardness is only 3·75, which is a good deal less than that of felspar.

B B, it becomes white but does not melt. With carbonate of soda it melts into a green colored bead, and on adding nitre the color becomes red: with borax it fuses into a colorless bead.

GIGANTHOLITE.

M. Nordenskiöld and *Count Trolle Wachtmeister.*[†]

This mineral, discovered and first described by M. Nordenskiöld, has also been described and analyzed by the latter. It occurs in considerable masses in quartz, at two localities near Temmela in Finland. It is composed of

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[*] From *περιστερά, a pigeon*, the colors resembling a pigeon's neck.

[†] Trans. Swedish Roy. Sci. Acad., 1837, p. 136. Also Berzelius's Rapport Annuel for 1839, p. 296; and for 1842, p. 118.

Silica	46·27
Alumina	25·10
Protoxide of iron	15·60
Magnesia	3·80
Protoxide of manganese	0·89
Soda	1·20
Potash	2·70
Water	6·00
	101·56

It has also been analyzed by M. Komonen, and both analyses accord with the following formula, as given by Trolle Wächtmeister: $(F, M, Mg, K, N)S^3+3AlS+Aq$.

Sp. Gr. 2·862—2·878. H. between calc spar and fluor spar.

Color externally steel-grey, but the fresh cleavage surfaces have a metallic brightness, with a color which plays between grey and yellow into a brown. The crystals, some of which are 2½ inches in diameter, are twelve-sided, and appear to be composed of laminæ half a line to three lines in thickness, between which thin layers of chlorite are interposed. These laminæ project out along the sides of the crystals, as if it were made up of thicker and thinner twelve-sided plates glued together. They present terminal faces, but never complete, and entire isolated crystals have not been found. The primary form, as indicated by cleavage, is a rhombohedron, into which, however, it does not appear to have been reduced. It resembles, in its physical characters, fahlunite and the harder varieties of talc. In a red heat it gives off water which contains a little ammonia. It decomposes gradually in damp air, but is reduced to a white powder with great difficulty by mechanical means.

Brooke supposes this mineral and the Phyllite* of Dr. Thomson to be identical. The latter is in thin plates, without any regularity of form; color brownish; having a semi-metallic lustre, with the hardness and specific gravity of the former, and agreeing with it nearly in chemical composition.

FAUJASITE.

M. Damour. (*Annales des Mines*, 1842, t. i., p. 395.)

The substance which has been described and analyzed by M. Damour, and has received its name in honor of M. Faujas de Saint Fond, well known by his labors on extinct volcanos, was first noticed by the Marquis de Drée in the amygdaloidal rocks of Kaisersthul. The analysis gave

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* Named from φυλλον, a leaf; found in mica slate at Sterling, Mass., by Prof. Nuttall, and analyzed by Dr. Thomson.

Silica	49·36
Alumina	16·77
Lime	5·00
Soda	4·34
Water	22·49
	97·96

These numbers lead to the formula, as given by M. Damour: $3\text{Al}S^2+(\text{Cal},N)S^4+8\text{Aq}$.

Sp. Gr. 1·923. H. little harder than glass.

It occurs in crystals which are for the most part colorless and limpid, some being tarnished on the surface, and others of a brown color, appearing of a brilliant reflection, like that of zircon or diamond. They are fragile; fracture vitreous and uneven. These crystals present the form of an octahedron with a square base, of which the height is to the side of the base, almost as four to three. The crystals recently obtained offer no modifications on the angles or edges; and in only a single instance have they been observed with secondary modifications, or in hemitropes, presenting the usual figure of an octahedron, in which one portion of it is supposed to have turned half round, as shown by fig. 2, under spinel. The angles have been thus determined with the reflecting goniometer by M. de Drée and M. Descloizeaux — P on P, over the summit, 74° 30′ (see fig. on p. xxxii. of the Introduction to this volume), P on P adjacent, 111° 30′, P on P 105° 30′. When heated in a tube the crystals give out water, but preserve their transparency. B B, they swell up and melt into a white enamel; with salt of phosphorus, on platinum wire, they entirely disappear, the globule becoming milky white on cooling. With a small quantity of carbonate of soda the mineral intumesces, and gives a colorless and transparent glass. Treated with chloride of platinum, it shows the presence of potash.

The amygdaloid, in the cavities of which this mineral occurs, is penetrated on all sides by crystals of black pyroxene, and by a brownish substance, resembling hydrate of iron. The rock has a great resemblance in other respects to that which contains hyalosiderite.

M. Damour observes that the very small quantity of this mineral operated upon renders a new analysis desirable; but the great quantity of water it contains, its position, and, above all, its crystalline form, authorize the belief that it constitutes a new species.

ROSITE.

M. Svanberg (*Ann. des Mines*, 1842, t. ii., p. 474, and *Jameson's Edin. Phil. Jour.*, vol. xxxii., p. 150.)

This is the name given by Svanberg to a new mineral from

Aker, long taken for amphodelite, which it closely resembles in external characters. Its analyses gave

Silica	44·901
Alumina	34·506
Peroxide of iron	0·688
Oxide of manganese	0·191
Potash	6·6.8
Soda	trace
Lime	3·592
Magnesia	2·498
Water	6·333
	99·337

Formula: $(K,C,Mag,)S^2+6AS+2Aq.$

Sp. Gr. 2·72. H. between calc-spar and gypsum.

It is found disseminated in calc-spar in grains about the size of hemp seed. It is not regularly crystallized, but has a crystalline fracture, with natural cleavage planes. When heated B B, it gives off water and loses color. It melts with great difficulty into a white slag; with borax and microcosmic salt, it fuses with great difficulty; with soda it melts easily, and an additional quantity does not render it less fusible. The distinctions between it and amphodelite are these: that amphodelite scratches fluor spar, but rosite is scratched by it; amphodelite is more difficultly fusible alone, and easily so with a little soda, but with a larger quantity is infusible.

LEUCOPHANE.

M. Erdmann. (*Ann. des Mines*, 1842, t. ii., p. 448; and *Jameson's Edin. Phil. Jour.*, vol. xxxii., p. 149.)

This mineral was discovered by Esmark, near the mouth of the Langesundfjord, in Norway; and it has been analyzed by Erdmann. These are his results:

Silica	47·82
Glucina	11·51
Lime	25·00
Protoxide of manganese	1·01
Potassium	0·26
Sodium	7·59
Fluorine	6·17
	99·36

Formula: $2NFl+3(GS+2CalS^3.)$

Sp. Gr. 2·974. H. about that of fluor spar.

Leucophane is seldom regularly crystallized, but has three distinct cleavages. When cleaved it gives four-sided prisms, with angles of 53° 24′ 7, and 36° 26′ 3, which appear to belong to the triclinometric system. Color varies from pale impure green to dark wine-yellow; in thin plates it is colorless; it gives a bluish phosphorescent light, and becomes slightly electric when heated; melts, B B, into a clear, somewhat violet enamel; with borax gives a clear amethyst glass; with a little soda it gives an opake globule; with more it melts into the charcoal; with microcosmic salt in a tube it gives fluosilicic acid gas. It occurs in sienite, along with albite, elaolite, yttrotantalite, and another new mineral named Mosandrite.

MESOLE.

Flabelliform Kouphone Spar, *Haidinger*. (*Brewster's Jour.*, vii. 18.) Vulcanus flabelliformis, D.

	Sweden.	Annaklef.	Faroe.	Antrim.
Silica	42·17	41·51	42·60	44·84
Soda	10·19	10·80	5·63	5·56
Alumina	27·00	26·84	28·00	28·48
Lime	9·09	8·07	11·43	10·68
Water	11·77	11·79	12·70	10·28
	100·15 Hisinger.	99·01 Hisinger.	100·36 Berzelius.	99·84 Thom'n.

Sp. Gr. 2·35 — 2·4. H. = 3·5.

In implanted globules, which have a flat columnar or lamellar structure radiating from the centre; color greyish-white, sometimes yellow; translucent, with a silky or pearly lustre; cleavage perfect parallel to the broad face of the individual; laminæ slightly elastic.

It occurs at Nalsoe in the Faroe Islands, coating the cavities of basalt and amygdaloid, and associated with chabasie, apophyllite, stilbite, and others of the zeolite family; also in Disco Island, Greenland, in large individuals, which have a silvery lustre, a distinctly lamellar composition, and which bear much resemblance to crystallized spermaceti. Skagastrand in the north of Iceland, and Rostanga in Scania, Sweden, are likewise localities of mesole. It is distinguished from mesotype by its perfect single cleavage and pearly lustre; from stilbite or heulandite by its superior specific gravity; and from apophyllite by its crest or fanlike aggregations, which never occur in that mineral. When associated with apophyllite or stilbite, it always forms the lowest stratum, immediately adjoining the basalt or amygdaloid, in the cavities of which it is deposited. — *Allan's Manual.* A mineral in globular masses, very nearly resembling this, has lately been found on New York Island in gneiss, accompanied by stilbite. And Dr. Thomson has analyzed a mineral called by him Harringtonite, which in composition agrees with mesole; of which it is probably a compact variety. Its analysis is given above.

NEEDLESTONE. MESOLITE.[*]

Fuchs and Gehlen. (*Schweigger's Jour.*, xviii., 11.)

Combination of silica, alumina, lime, soda, and water.

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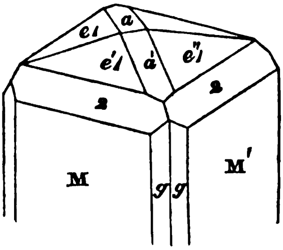
[*] From μεσος, *middle*, and λιθος, *a stone*: it being intermediate between mesotype and scolezite.

	Iceland.	Pargas.	Faroe.
Silica	47·00	46·80	47·50
Soda	5·47	5·40	4·57
Alumina	26·13	26·50	26·10
Lime	9·35	9·87	9·15
Water	12·25	12·30	12·80
	100·20 Gehlen.	100·87 Berzelius.	100·12 M. Durocher.

Sp. Gr. 2 26. H. = 5·0 — 5·5.

It occurs massive, and also in long slender prisms terminated by quadrilateral pyramids. It cleaves parallel to the sides of a Right rhombic prism, corresponding in measurement with that of mesotype; there is also a remarkable agreement in some of its secondary planes with those of that mineral, of which it would thence appear to be merely a variety. The prisms are translucent, or transparent and colorless, or of a greyish color, externally shining with a somewhat pearly lustre. B B, it becomes opake and curls up, and finally melts with the extrication of air-bubbles, into a porous and almost opake bead.*



M on M	91°	22'
—— e'1 or M' on e''1	117	10
—— e'2 or M' on e''2	146	38
—— g	162	30
e'1 on e''1	144	15
e'1 on e1	142	10
e'1 or e''1 on a'	162	15
e''1 on e'2	150	42

The finest specimens of this mineral are found in the Berufiord, Iceland. In those the crystals often exceed two inches in length, and diverge or interlace in the most beautiful manner. It occurs in colorless transparent radiated masses, also compact and opake in the trap district of the Vendayah Mountains, Hindostan; in Greenland; in Bohemia; at Pargas in Finland, and the Faroe Islands, where it forms white fibres of a silky lustre, grouped in radii.

BREVICITE.

Berzelius. (*Poggendorf's Annalen*, xxxiii., 112.)

This name has been given by Berzelius to a mineral sent to him by M. Strom. By the analysis of M. Sonden it contains soda 10·32, silica 43·88, alumina 28·39, lime 6·88, magnesia 0·21, and water 9.63.

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* The variety which has been called scolezite (from its curling up like a worm, B B,) agrees in crystalline form, and in its essential physical characters, so nearly with this species, that we do not seem authorized to separate them. The difference in composition is no more than that which we often see in the analysis of two specimens of the same mineral by different chemists. It must be confessed that there is not a little confusion attending the classification of several of these minerals, which approach each other so nearly that further examinations will probably unite them into a fewer number of species. [Am. Ed.]

In transparent prismatic crystals and white foliated or radiating masses, occupying the cavities of a trachytic rock at Brevig in Norway, the striæ occasionally of a dark-red hue. Its crystallographical characters have not been mentioned.

GMELINITE.*

Hexahedral Kouphone Spar, *Haid.* Sarcolite, *Vauquelin.* Hydrolite, *De Drée.* Gmelinite, *Brewster.* (*Edin. Jour. of Sci.*, ii., 262.) Vulcanus exfolians, D.

Combination of silica, alumina, lime, soda, and water.

	Montecchio Maggiore.	Castel.	Antrim.
Silica	50·0	50·00	39·89
Soda	4·5	4·25	0·00
Alumina	20·0	20·00	12·96
Potash	0·00	0·00	9·00
Protoxide of iron	0·00	0·00	8·27
Lime	4·5	4·25	0·00
Water	21·0	20·00	29·86
	99·50 Vauquelin.	98·50 Vauquelin.	99·92 Thomson.†

A very pure specimen of Irish gmelinite, in colorless and nearly transparent crystals, has recently been analyzed by Connell,‡ with a result differing very considerably from the above, and which will probably be taken as the true composition of the species. It is as follows :

	Antrim.
Silica	48·56
Alumina	18·05
Lime	6·13
Soda	3·85
Potash	0·39
Oxide of iron	0·11
Water	21·66
	98·75

Formula as indicated by this analysis, and stated by Connell: $(\mathrm{Cal}, \mathrm{N}, \mathrm{K})\mathrm{S}^3+3\mathrm{AlS}^2+7\mathrm{Aq}$.

It differs from chabasie, with which it has been supposed to be allied crystallographically, in containing one atom more of silica and water; and from Levyne in containing two atoms more both of silica and water.

Sp. Gr. 2·0 — 2·1. H. = 4·5.

Primary form an obtuse rhomboid. Secondary form a flat six-sided prism, terminated at both extremities by truncated six-sided pyramids. Crystals sometimes united in groups.

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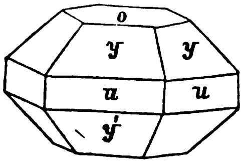
* Gmelinite, in compliment to Professor Gmelin of Tubingen.

† Only 5·3 grains were employed in the analyses.

‡ Edin. Phil. Jour. xxiv., 362.



y on y' over u . . . . . . 83° 36'

Color white, passing into flesh-red; translucent; lustre vitreous; streak white; cleavage distinct parallel to the faces of the primary, fracture uneven; surface of the prism striated horizontally. It is soluble in acids. Its behaviour B B is thus described by Sir David Brewster. "Small portions gradually raise themselves, and after standing on their ends, as if they were under the influence of electricity, they are propelled with violence from the fragment." (Variety from Antrim.) In the blow-pipe flame, *per se*, it increases in bulk, assumes the appearance of an enamel, but does not melt into a glass; in the matrass it gives off its water, and is reduced to powder. "The low degree of hardness remarked by Vauquelin, (*Mohs*, *Min.*, vol. iii., p. 105,) and the forms presented by this mineral from the Vicentine, prove incontestibly that this mineral nearly agrees with rhombohedral kouphone spar, or chabasie." Gmelinite occurs coating the cavities of amygdaloid rocks at Montecchio Maggiore, and Castel in the Vicentine; of a white color in the Deer Park of Glenarm, County Antrim; and presenting a flesh-red tinge at the Island Magee, near Larne. It has recently been brought from Owhyhee, one of the Sandwich Islands, where it occupies small cavities in the lava.

COMPTONITE.*

Comptonite, *Brewster*. (*Edinb. Phil. Jour.*, iv., 132.) *Brooke*. (Ibid. vi., 112.) Comptonitic Kouphone Spar, *Haidinger*. Vulcanus Comptonianus, D.

Contains according to Dr. Thomson, (*Outlines*, *&c.*, vol. i., p. 356.) —

Silica	36·80
Alumina	24·52
Lime	10·89
Peroxide of iron	3·66
Soda	5·58
Water	13·69
	95·14

Formula: $8AlS+2CalS^2+NS+9Aq.$

Sp. Gr. 2.35 — 2·4. H. = 5·0 — 5·5.

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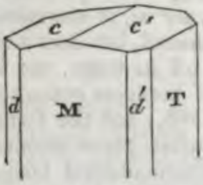
* Named by Dr. Brewster, in honor of Lord Compton — the present Earl of Northampton — by whom it was first distinguished.

It is found in translucent white crystals, which yield to cleavage parallel to the planes, M and T of the following figure; the primary form, according to Brooke, is a Right rectangular prism, of which the bases are not square. Frequently the edges of the prism are replaced by planes, converting it into an eight-sided prism, and the base is also replaced by two very low planes meeting at an angle of 177° 5′, as shown below. Lustre vitreous; streak white; fracture small conchoidal, and uneven; scratches stilbite, but not mesotype. By exposure in powder to the action of nitric acid, it is convertible into a jelly. B B, it gives off water, intumesces slightly, becomes opake, and then fuses imperfectly into a vesicular glass; the globule obtained with borax is transparent; that with salt of phosphorus contains a skeleton of silica and becomes opake on cooling.



M on T	90°	00′
T on c′.....	93	00
c on c′	177	5
M on d′	135	35

This mineral occurs among the vesicular lava of Vesuvius, associated with mesotype and other species. It has also been noticed in basalt at the Pflaster Kaute, near Eisenach in Hessia; forming a thin coating on the surface of mesotype, and occupying the cavities of *graustein* at Hauenstein in Bohemia; and associated with analcime and Phillipsite at the Cyclopean Isles, Sicily.

LEDERERITE.*

C. T. Jackson. (*Am. Jour. of Sci.*, xxv., 78.)

This mineral is composed, according to the analysis of A. A. Hayes, (*Am. Jour. of Sci.*, xxv., 84,) of silica 49·47, alumina 21·48, lime 11·48, soda 3·94, phosphoric acid 3·48, oxide of iron 0·14, water 8·58.

Sp. Gr. 2·10. H. = 6.

It occurs in crystals which are sometimes colorless and transparent, but usually white and opake, or only translucent on the edges, some of them being of a pale salmon color. The crystals are in the form of hexahedral prisms, deeply replaced on their terminal edges, or terminated at both extremities by hexahedral pyramids, having at their summits a small plane termination, perpendicular to the axis of the prism; indicating a regular hexahedral prism for the primary form. This form is further indicated by the separation of faces of cleavage made visible by exposure to heat. B B, according to Hayes, it becomes white, and divides at the natural joints; at a higher temperature it fuses into a white enamel, which can be rendered more vitreous by continuing the blast; a few bubbles are disengaged when it is thus treated. In the matrass, a slight empyreumatic odor is perceptible. Its inferior hardness and specific gravity, but more especially its pyrognostic characters and chemical composition, clearly separate it from the species hydrolite, or gmelenite, to which it has been referred: one consisting of bisilicates of alumina and lime, silicate of soda, with six per cent. phosphate of lime, and only 8·58 water; the other, by Mr. Connell's analysis, of bisilicate of alumina, tersilicate of lime, soda and potash, no phosphoric acid, and 21·66 per cent. water.

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* Named in compliment to the Austrian minister to the United States, the late Baron Von Lederer, a well known friend of American mineralogy.

Some of the crystals are elongated, and measure one third of an inch in the direction of the prismatic axis, but most of them possess nearly equal dimensions in the opposite direction, or they are sometimes even in low flattened prisms. The secondary planes on the edges incline on M, at an angle of 130° 5′, and towards each other, at 142° 10′, as determined by the reflective goniometer, by M. Dufrénoy, of the School of Mines in Paris. Ledererite was discovered by Dr. Jackson and the editor, between Cape Split and Cape Blomidon, Nova Scotia, in the cavities of amygdaloid, accompanied by calcareous spar, mesotype, analcime and stilbite. It has become a very rare mineral, and is no longer found at the locality.*

HYPOSTILBITE.

Beudant. (*Traité*, t. ii., p. 119.)

Composition as follows:

	Faroe.	Faroe.
Silica	52·43	52·25
Alumina	18·32	18·75
Lime	8·10	7·36
Soda	2·41	2·39
Water	18·70	18·75
	99·96 Beudant.	99·50 Duméril.

Formula as given by Beudant: $3AlS^3+CalS+6Aq$.

Sp. Gr. 2·14. Does not scratch glass.

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* The same name has since been applied to a variety of sphene from Grenville, Upper Canada, by Prof. Shepard.

Either in white dull globules, consisting of delicate fibres, or compact; fracture devoid of lustre. Soluble in acid without forming a jelly. B B, fuses with difficulty on the edges only, intumesces slightly, and becomes externally rough. Locality, the Faroe Islands, where it occurs associated with stilbite and epistilbite in amygdaloid rocks.

EPISTILBITE.

Diplogenic Kouphone Spar, M. Epistilbite, *Prof. G. Rose.* (*Brewster's Jour.*, iv., 283.) Vulcanus acutus, D.

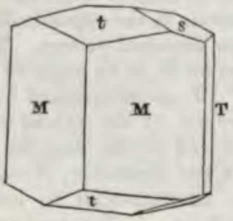
Combination of silica, alumina, lime, soda, and water.

	Iceland.	Faroe.
Silica	58·59	58·61
Soda	1·78	1·20
Alumina	17·52	17·03
Lime	7·56	8·21
Water	14·98	13·80
	99·93 Rose.	98·85 Beudant.

Formula according to Beudant: $3AlS^3+CalS^3+5Aq$.

Sp. Gr. 2·2—2·25. H. = 4·0—4·5.

Primary form a Right rhombic prism of 135° 10′ and 44° 50′.



s on *s*	147°	40′
M on M	135	10
t on *t*	109	46

Commonly in macled crystals. Color white or yellowish; varying from transparent, to translucent only on the edges; lustre vitreous, except on the faces of cleavage, and the corresponding crystalline planes, which are pearly. Cleavage highly perfect parallel to T. Alone, B B, it melts, becomes white, intumesces, and forms a blebby enamel; and with soda fuses into a transparent glass. In concentrated muriatic acid it is dissolved, with the exception of a fine granular residue of silica.

Epistilbite occurs in large distinct crystals, along with others of the zeolite family, in the trap-rocks of Iceland and the Faroe Islands. It was distinguished from stilbite by Prof. G. Rose, of Berlin. Dr. Brewster also examined it optically, and ascertained that it exhibited but one system of polarized rings.

SPHEROSTILBITE.

Beudant. (*Traité*, t. ii., p. 170.)

Composition according to three analyses:

	Faröe.	Iceland.	Vagöe.
Silica	55·25	55·61	56·50
Alumina	17·25	16·68	16·50
Lime	7·30	8·17	8·48
Soda	1·85	1·53	1·50
Water	19·25	19·30	18·50
	100·90 Beudant.	101·29 Gehlen.	101·48 Duméril.

Formula by Beudant, $3\text{AlS}^3+\text{CalS}^2+6\text{Aq}$.

Sp. Gr. 2·31. H. above 3·0.

In globular masses, which present a radiated structure, a pearly lustre, and a brilliant fracture. The fibres are flexible, and the surfaces of the globules may be scratched by the nail. It forms a jelly with acids; and fuses B B, with exfoliation and intumescence.

It occurs both in the Faroe Islands and in Iceland.

ERLANITE.

Breithaupt. (*Schweigger's Jour. of Chem.*, vol. vii., page 76.)

Silica	53 16
Soda	2·61
Alumina	14·03
Lime	14·39
Magnesia	5·42
Oxide of Iron	7·14
Oxide of manganese	0·64
Water	0·60
	98·99 Gmelin.

Formula: $3\text{AlS}^2+2\text{CalS}^2+\text{MgS}^2+(\text{N},\underset{.}{\text{F}})\text{S}$.

Sp. Gr. 3·0 — 3·1. H. = 6·25 — 7.

Occurs massive, occasionally compact, generally in small and fine granular concretions, of a light greenish-grey color. Lustre feebly shining, or dull. Streak shining, with a resinous lustre, and white; structure distinctly crystalline, but no regular cleavage has been observed; fracture in some specimens foliated, in others splintery. B B, it fuses readily into a slightly colored transparent compact globule; and with borax forms a clear greenish glass.

Erlamite is described as possessing the aspect of gehlenite. It was discovered by Breithaupt in the Saxon Erzgebirge, forming a part of the oldest gneiss formation. It appears to be a mere mechanical mixture.—*Allan's Manual.* This last remark may prove true only of the *erlan-rock*. This has been used for two hundred years as a flux by the iron smelters, and mistaken for limestone, until Breithaupt pointed out its true character.

HUMBOLDTILITE.*

Monticelli and Covelli. Somervillite *of Brooke*, (p. 514 *Ency. Brit.*, *Art. Min.*)

Contains according to the following analyses,

Silica	43·96	49·36
Lime	31·67	31·96
Magnesia	8·83	6·10
Alumina	0·50	11·20
Protoxide of iron	2·00	2·32
Soda	0·00	4·28
Potash	0·00	0·38
	86·96 Monticelli and Covelli.	105·60 Kobell. †

These last results are so unlike the first, as to render it probable that the specimen analyzed by Kobell, was not a pure one; and it gives an excess of over five per cent. Adopting the first analysis by the discoverer of the mineral, the atoms of silica are about twice as many as those of the bases.

Primary form a Right square prism, the lateral edges of which are frequently replaced by one or more planes. Cleavable parallel to the base. Color greyish-yellow or grey; lustre vitreous, passing into resinous; fracture conchoidal or uneven; between transparent and feebly translucent. B B, *per se* it fuses readily, with a slight intumescence, into a diaphanous glass, which is blebby, and in color resembles the mineral, only that it has a more grey or greenish hue. With borax it melts slowly into a colorless glass. Reduced to powder after being calcined, it is quickly soluble in acid, forming a very characteristic jelly.

Humboldtilite occurs in the cavities of matter ejected from Vesuvius.

LAPIS-LAZULI.‡

Lazurstein, W. Lazulite, H. La Pierre d'Azur, Br. Azure-stone, J.

Combination of silica, alumina, lime, oxide of iron, magnesia, soda, and sulphuric acid.

Silica 49·0, alumina 11·00, lime 16·0, soda and potash 8·0, oxide of iron 4·0, magnesia 2·0, sulphuric acid 2·0. — *Gmelin.*

Sp. Gr. 2·95.

This mineral is found massive; also, though rarely, in rhombic dodecahedrons, of an azure blue color; the texture of the massive is fine grained or compact with a glimmering lustre, and it is hard enough to scratch glass, though it scarcely gives sparks with steel; it is nearly opake; and its blue color is not uniform, as it frequently encloses iron pyrites, compact felspar, and quartz. On charcoal it fuses with difficulty into a

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[*] Named by the Italian mineralogists in honor of Baron Humboldt.

[†] Jahresbericht by Berzelius, for 1832, p. 169.

[‡] Lapis-lazuli, azure-stone, from its blue color

white glass when pure: with salt of phosphorus is soluble with effervescence, the portion melted burning with great brilliancy: with soda is partly soluble into an opake greenish-grey glass, which assumes a red appearance on cooling; and if previously calcined and reduced to powder, loses its color in acid. The finest specimens are brought from China, Persia, Lake Baikal in Siberia, and Bucharia. Beautiful specimens have been obtained in Bolivia, near Atacama, and in the Province of Copiapo, in Chili, by J. L. Blake. Lapis-lazuli is prized by the lapidary, but is chiefly important as affording that beautiful pigment called ultra-marine, so highly valued by painters.

NEPHELINE.

Nephelin, W. H. Sommit, *Kersten*. Rhomboidal Felspar, J. Rhombohedral Felspar, M. Sommite. Spatum hexagonum, D.

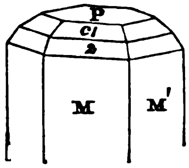
Combination of soda, silica, and alumina.

	Katzenbuchel.	Vesuvius.
Silica	43.36	44·11
Soda	13·36	20·46
Alumina	33·49	33·73
Potash	7·13	0·00
Lime	1·90	0·00
Oxide of iron and manganese	1·50	0·00
Water	1·39	0·62
	101·13 Gmelin.	98·92 Arfwedson.

Formula from the last analysis: $3AlS+NS$.

Sp. Gr. 2·5 — 2·6 H. = 6·0.

Occurs in regular six-sided prisms (the form of the primary crystal,) of which the terminal edges are sometimes replaced. It may be cleaved, though imperfectly, parallel to all the planes of that solid; fracture conchoidal; colorless or greyish-white, with a shining vitreous lustre; transparent or translucent. B B it is fusible into a blebby colorless glass. With salt of phosphorus is soluble, without effervescence, and leaving a silica skeleton, into a glass which becomes opaline on cooling; and with borax fuses slowly into a transparent colorless globule. A translucent fragment, when immersed in nitric acid, assumes a nebulous appearance (whence the name nepheline, from νεφελη, *a cloud*); and is finally converted into a jelly. When reduced to powder it gelatinizes in heated muriatic acid.



M on M′	120°	00′
P on M or M′	96	00
—— c1	151	53 H.
—— c2	135	40
M on c1	118	7 H.
—— c2	184	20

The fine white crystals of this species are as yet almost peculiar to that part of Vesuvius called Monte Somma, where they occur in cavities accompanied by garnet, hornblende, mica, and idocrase; it has been met with in the lava of Capo di Bove, near Rome; and, indistinctly crystallized, engaged in clinkstone at Katzenbuchel near Heidelberg.

ITTNERITE.*

Gmelin. Leonhard. (*Schweigger's Jahrbuch*, vi., 74.)

Silica	30·016
Soda	11·288
Alumina	28·400
Lime	5·235
Potash	1·565
Water	10·759
Oxide of irom	0·616
Sulphate of lime	4·891
Muriate of soda	1·618
	98·388 Gmelin.

The composition of this mineral, throwing out the gypsum and common salt, which are doubtless accidental, is thus expressed by Beudant and Dr. Thomson — $3\mathrm{AlS}+(\mathrm{N}, \mathrm{Cal}, \mathrm{K})\mathrm{S}+2\mathrm{Aq}$.

Sp. Gr. 2·3. H. = 5·0 — 6·0.

Primary form the rhomboidal dodecahedron. Fracture imperfect conchoidal, passing into uneven. Color bluish grey or ash-grey; lustre resinous, inclining to vitreous. B B, on charcoal it fuses *per se* with strong effervescence, and the disengagement of sulphurous acid, into an opake blebby glass, which the solution of cobalt colors blue; is imperfectly soluble in salt of phosphorus; with borax melts easily into a transparent colorless globule; and with soda is changed into an opake glass. It dissolves quickly in acids, forming with them a jelly.

This mineral, which bears much analogy with hauyne and sodalite, is found in basalt at Kaiserstuhl in the Brisgau near Freyburg. Beudant considers it a hydrous variety of nepheline.

NUTTALITE.

Nuttalite, *Brooke.* (*Annals of Philosophy*, xli., p. 366.) Nuttalit. L.

Contains, according to the analysis by Muir,†

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* In honor of M. Von Ittner, its discoverer.

† Dr. Thomson's Outlines of Mineralogy, &c., i., p. 383.

Silica,	37·61
Alumina	25·10
Lime	18·33
Protoxide of iron	7·69
Potash	7·30
Water	1.50
	97·93

Formula: $3AlS+2(\frac{4}{6}Cal+\frac{1}{6}\underline{F}+\frac{1}{6}K)S$. It is thus shown to differ essentially from scapolite in chemical composition.

Its primary form is a Right square prism, in which it occurs of the same dimensions, under the same modifications with scapolite, but is more rarely surmounted by pyramids. Cleavage parallel to the lateral planes. Fracture uneven. It bears generally considerable resemblance to scapolite, but it is softer and more vitreous in the fracture; it also possesses a beautiful chatoyant reflection of light on the faces of the prism. Color white, in some parts yellowish, in others bluish, green and grey; the yellow portions transparent, the blue nearly opake. Streak white; lustre vitreous. B B, it melts into a colorless glass, and with borax forms one which is blebby and pale white.

The locality of this mineral is Bolton, Mass., where it occurs in coarse granular limestone, with epidote and titanium ore. It was named by Brooke in honor of Prof. Nuttall, to whom American mineralogy has been much indebted.

ELÆOLITE.*

Fettstein, W. Pierre Grasse, *Levy*. Lythodes. Spatum oleaceum, D.

Contains Silica	44·00	44·190
Alumina	34·00	34·424
Lime	0·12	0·529
Potash	0·00	4·733
Soda	16·50	16·874
Peroxide of iron	4·00	0·651
Water	0·00	0·687
	98·62 Vauquelin.	102·088 Gmelin.

These numbers give very nearly three atoms silicate of alumina, and one atom silicate of soda and potash. Formula: $3AlS+(\frac{1}{6}K+\frac{5}{6}N)S$.

Sp. Gr. 2·54—2·62. H. = 5·5—6·0.

Primary form a Right rhombic prism of about 112° and 68°. It occurs massive, of a dark green, bluish-grey, or brick-red color; translucent; lustre resinous; frequently opalescent when cut; cleavage both parallel and perpendicular to the axis of a four-sided prism; fracture conchoidal. It gelatinizes freely with acids when reduced to powder; and B B it fuses into a white enamel. It is found in Norway, imbedded in the zirconsyenite of Laurvig, Stavern, and Fredrickswärn. The pale blue has a slight opalescence like cats-eye, whence it is occasionally employed for ornamental purposes. This mineral is included under the species nepheline by Beudant.

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* From the Greek *ελαιον*, *oil*, and *λιθος*, a *stone*, in allusion to its peculiar resinous or oily-like lustre.

HAUYNE.*

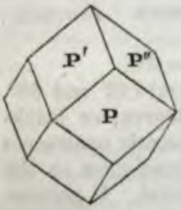
Hauyn, *Karsten.* Latialite, H.

Combination of potash or soda, silica, alumina, lime, and sulphuric acid.

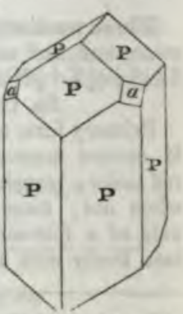
		Spinellane.		
	Marino.	Lake of Laach.	Lake of Laach.	Lake of Laach.
Silica	35·48	43·0	38·50	37·00
Potash	15·45	00·0	0·00	0·00
Soda	0·00	13·0	16·56	12·24
Alumina	18·87	29·5	29·25	27·50
Lime	12·00	1·5	1·14	8·14
Oxide of iron	1·16	2·0	1·50	1·15
Sulphuric acid	12·39	1·0	8·16	11·56
Oxide of manganese	0·00	6·0	1·00	0·00
Water	1·20	2·5	3·00	1·50
	96·55 Gmelin.	98·5 Klaproth.	99·11 Bergemann.	99·09 Bergemann.

Owing to the different results of these several analyses, the formula is omitted. Sp. Gr. 2·68 — 3·0.

The Haüyne is usually found in grains and massive; but it has been observed in extremely brilliant crystals, in the form of the rhombic dodecahedron. When this mineral is opake, it is of an indigo-blue color; when translucent, blue or bluish-green; is somewhat harder than quartz, and very brittle; fracture conchoidal, and considerably splendent. B B, on charcoal, it loses its color, and fuses slowly into an opake mass; with borax it forms a diaphanous glass, which becomes yellow on cooling; with salt of phosphorus is decomposed with effervescence, leaves a silica skeleton, and becomes opaline on cooling; is reducible into a white transparent jelly in heated acid.



P on P′ or P on P″ or P′ on P″ } 120° 00′
a on *a* 90 00
a on any adjoining plane P 135 00



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* Haüyne, in honor of the late celebrated French mineralogist, Haüy.

It occurs either disposed in the cavities of volcanic debris, as at Vesuvius, and in the neighborhood of Rome; or imbedded in lava or pumice, as near Andernach, on the Rhine.

Haüyne is distinguished from lazulite by its vitreous lustre, a character which the latter does not possess, and also by its different chemical composition. By some authors it has been classed with sodalite; but the analysis of this mineral by Gmelin and Bergemann, would seem to show too great a discordance, both qualitively and quantitively, for uniting it with that species.

Spinellane. Spinellane, *J. H.* Nozin, *Leonhard.* This mineral was described as a distinct species in the last edition of this work, but it is obviously only a variety of the present species, and as such it is now classed in the latest works. Its crystalline form is the rhomboidal dodecahedron, sometimes elongated (as in several of the garnets) into six-sided prisms with trihedral terminations, as shown in the above figure. Its color is ash-grey, the crystals being generally small, though distinctly formed, and translucent. It cleaves with brilliant surfaces, parallel to the faces of the dodecahedron; scratches glass, but is brittle; specific gravity 2·28. B B, it whitens, but does not melt, either alone, or with additions. It occurs in the drusy cavities of glassy felspar on the borders of the Lake of Laach, near Andernach on the Rhine, with quartz, black mica, and magnetic iron. Its above analyses, by Klaproth and Bergmann, differ so considerably that it is not improbable that these chemists may have operated on different minerals. The analysis by the former would make the mineral to consist of a sesquisilicate of alumina and soda.

HYDROUS ANTHOPHYLLITE.

Dr. Thomson. (*Outlines, &c.*, vol. ii., p. 209.)

Composed of silica 54·98, magnesia 13·37, peroxide of iron 9·83, protoxide of manganese 1·20, potash 6·80, alumina 1·56, water 11·44. Dr. Thomson rejects the alumina and protoxide of manganese as accidental, and records the following formula: $4MgS^3+\underline{F}S^3+KS^3+7\frac{1}{2}Aq.$

Sp. Gr. 2·91. H. = 2·5.

Color greenish-yellow; texture diverging fibrous; specimens consisting of irregular crystals, diverging from various centres and sometimes much interwoven with each other; fibres separable from each other, but less perfectly than those of asbestus. They are fine, easily broken, and destitute of elasticity: lustre silky; opake; sectile; feel soft.

This mineral was formerly known to American mineralogists as radiated asbestus. It occurs in place, and in boulders, on the west side of New York Island, where it forms a bed between granite and gneiss. It was sent to Dr. Thomson, for analysis, by Prof. Torrey, of New York.

ANTRIMOLITE.

Dr. Thomson. (*Outlines, &c.*, vol. i., p. 326.)

This mineral was discovered on the north coast of the county of Antrim, in the vicinity of the Giant's Causeway. Its constituents, by Dr. Thomson's analysis, are the following: silica 43·470, alumina 30·260, lime 7·500, potash 4·100, protoxide of iron 0·190, chlorine 0·88, water 15·320.

Formula: $5\mathrm{AlS}+(\frac{3}{4}\mathrm{Cal}+\frac{1}{4}\mathrm{K})\mathrm{S}^3+5\mathrm{Aq}$.

Sp. Gr. 2·0964. H. = 3·75.

Its color is chalk-white; texture fine silky fibrous, the fibres diverging from the central nucleus like radii from a common centre. It is opake, and dull. It has not been found in distinct crystals, but composes long stalactitical masses, which adhere to the summits of cavities in amygdaloid. The centre of these masses encloses a foliated variety of calcareous spar, upon which the antrimolite has implanted itself.

When heated it gives out water, which reddens vegetable blues, and contains muriatic acid. The quantity driven off amounts to 15·42 per cent. B B, it does not froth, but softens into an enamel. With biphosphate of soda it dissolves very slowly into a transparent colorless glass. It dissolves readily, and gelatinizes in muriatic acid.

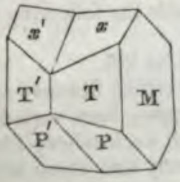
PERICLINE.

Heterotomous Feldspar, M. Periklin, *Breithaupt.* Spatum gemellum, D.

Contains soda 9·99, potash 2·41, silica 69·91, alumina 18·93, lime 0·15, oxide of iron 0·48 — from Zöblitz, by Gmelin.

Sp. Gr. 2·54 — 2·56. H. = 6·0.

It occurs in twin crystals, closely resembling in its measurements those of albite, with which, also, it almost precisely agrees in chemical composition.



P on M . . . . 93° 19′
P on T 114 45
M on T 120 18

Cleavage perfect parallel to P and T; more so to T than to M, the reverse of which is the case in albite. Lustre pearly; color white, yellowish or reddish.

It occurs in large distinct crystals at St. Gothard in Switzerland; in the Pfundersthal and Schmiernerthal in the Tyrol; upon the Sau-alpe in Carinthia, at Zöblitz in Bohemia, and other places. It is more generally opake than albite or felspar, and its specific gravity is lower.

LABRADORITE.

Labradorstein, W. Feldspath Opalin, H. Polychromatic Feldspar, M. Labradore Felspar. Spatum opalescens, D.

Combination of silica, alumina, lime, soda, and oxide of iron.

	Labrador.	Labrador.	Ingermania.
Silica	55·75	55·41	55·06
Alumina	26·50	26·92	24·00
Lime	11·00	10·89	10·25
Soda	4·00	4·39	3·50
Protoxide of iron	1·25	5·25	5·25
Water	0·50	0·64	0·50
	99·00 Klaproth.	103·50 Thomson.	98·56 Klaproth.

From the mean of these analyses, Dr. Thomson has given the formula — $3AS + (\frac{2}{3}Cal + \frac{1}{3}N)S$.

Sp. Gr. 2·7. H. = 6·0.

Its primary form is an Oblique rhombic prism of 119° and 61°. The cleavage parallel to the base is most perfect; lustre internally vitreous, pearly upon the perfect faces of cleavage; translucent when in thin fragments; color grey, with opaline reflections of a blue, yellow, or brilliant red hue. B B, on charcoal, it fuses quietly = 3, into a pretty dense clear glass, whose fracture is brilliant; is scarcely affected by salt of phosphorus, unless reduced to powder, when it is decomposed into a skeleton of silica, and a glass which becomes opaline on cooling; and with borax fuses slowly without effervescence into a diaphanous glass. When in powder it is entirely dissolved, and forms a jelly with heated muriatic acid.

Rough indistinctly formed crystals of considerable size were brought by Giesècké from Greenland; but the beautiful iridescent slabs to which the name of their locality is applied, are found at the island of St. Paul on the coast of Labrador, associated with hornblende, hyperstene, and magnetic iron ore. Magnificent labradorite has been found in the neighborhood of St. Petersburg in Russia, in Finland, and in the Ural mountains. A specimen from the former place was sold to the Duke of Devonshire for one thousand rubles. In the time of Catharine II., she valued the stone so highly, that snuff boxes of several small stones sold for fifteen hundred rubles. It occurs for the most part in boulders, but in Finland it forms considerable veins, accompanied by hornblende, magnetic iron and garnet. The colors of these specimens play between dark sapphire-blue, emerald-green, violet, gold-yellow, pinchback, brown and brass-yellow; the shades being weaker in the Mountain Labrador of Finland. Labradorite is found also on the Island of Sedlowatoi, in the White Sea, of a pale red color, with a weak azure change, like adular. Labradorite forms one of the constituents of a greenstone at Campsie Glen, and near Paisley in Scotland, according to Dr. Thomson.

This mineral has several localities in the United States, but the finest iridescent specimens have been found in New York, as in Essex and Lewis Counties, generally in rolled masses; and at Hammond, St. Lawrence County, in fine large crystals, associated with phosphate of lime, zircon and sphene. They receive a fine polish, but are much inferior to the specimens from Labrador.

ALBITE. CLEAVELANDITE.[*]

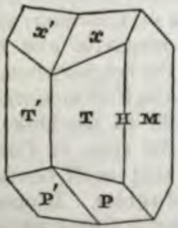
Tetarto-prismatic Feldspar, M. J. Cleavelandite, *Brooke* and *Levy*. Tetartin, *Breithaupt*. Spatum triclinatum, D.

Combination of silica, alumina, and soda.

	Finbo.	Arendal.	Chesterfield, Mass.	
Silica	70·48	68·46	70·68	70·94
Alumina	18·45	19·30	19·80	18·70
Soda	10·50	9·27	9·06	8·83
Lime	0·55	0·68	0·23	0·68
	99·98 Eggertz.	96·71 Rose.	99·77 Stromeyer.	99·15 Thomson.

There is a very close agreement among these four analyses. The mean gives silica 70·139, alumina 19·063, soda 9·414 — which, divided by the atomic weights, give of atoms of silica 35·07, of alumina 8·47, and of soda 2·35. The atoms of silica thus exceed three times the atoms of bases by 2·61, but if, as Dr. Thomson supposes, this excess is accidental, we obtain for the constitution of this mineral, three atoms tersilicate of alumina and one atom tersilicate of soda. Formula: $3AlS^3+NS^3$.

Sp. Gr. 2·6—2·68. H. = 6·0.



M on P	93°	30′
P on T	115	05
M on T	117	53
P on P′ the re-entering angle	186	40
P on *x*	127	28
T on *x*	110	29
Edge H often replaced by a plane which forms with M an angle of	119	52
and with P an angle of	119	51

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[*] From *albus*, white, in allusion to its color. Cleavelandite, in honor of Prof. Cleaveland of Bowdoin College. The name was at first applied to the laminated variety from Chesterfield, by Brooke, but it has now an equally extended application with albite.

Primary form, a Doubly oblique prism (see fig. 13, p. xl., of the Introduction). Generally in flat twin crystals, of which the face M is greatly enlarged. Color commonly white, sometimes grey, green, or brown, varying from transparent to opake. Lustre pearly upon cleavage planes, vitreous in other directions. Cleavage perfect parallel to M and P, less so to T. Its comportment, B B, resembles that of felspar, fusing quietly = 4.

Albite occurs in large transparent colorless crystals, with pearlspar, in the Tyrol; and at St. Gothard in white translucent twins, having a brilliant lustre; at Arendal with epidote and garnet; with eudyalite and hornblende in Greenland; also in Siberia, Norway, Sweden, Bohemia, Oisans in Dauphiné, and elsewhere on the continent. In the granite on the Mourne Mountains it is associated with felspar, from which, however, it may be distinguished by its superior whiteness and translucency. Felspar and albite indeed frequently occur in the same granite, as in that of Pompey's Pillar, and the block on which the statue of Peter the Great in St. Petersburg is placed, the albite presenting a greenish-white color, while the felspar is flesh-red. The crystals from Baveno are often extremely curious in this respect, the albite being disposed in parallel position upon the faces of the felspar, from which its greater whiteness distinguishes it. Albite, more frequently than felspar, is one of the constituents of syenite and greenstone, as in the rocks around Edinburgh. It is also a frequent constituent of the granite of England. Romé de l'Isle first distinguished it as a particular species under the name of white schorl; but it is to Dr. G. Rose that mineralogists are indebted for their more accurate knowledge of its properties. — *Allan's Manual.*

In the United States, it forms very considerable masses of a foliated structure, and is sometimes in crystals, at Chesterfield, Mass., where it is penetrated by crystals of rubellite and green tourmaline. It occurs also at Williamstown and Goshen in the same State, and at Paris, Maine, where the associated minerals are the same as at Chesterfield. It accompanies the chrysoberyl at Haddam, Ct., and is found in a granular form containing beryl at Munroe, Ct. It occurs in granite at Governeur, St. Lawrence County, N. Y., and in beautiful white, nearly transparent crystals at Granville, Washington County, N. Y., discovered by Prof. Emmons.

ANALCIME.

Kubizit, W. Analcime, H. Hexahedral Kouphone Spar, M. Hexahedral Zeolite, J. Vulcanus cubicus, D.

Combination of silica, alumina, soda, and water.

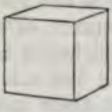
	Fassa.	Kilpatrick.	Giant's Causeway.
Contains Silica	55·12	55·07	55·60
Alumina	22·99	22·22	23·00
Soda	13·53	13·71	14·65
Water	8·27	8·22	7·90
	99·91 Rose.	99·22 Connell.	101·15 Thomson.

These analyses very nearly coincide, and they give for the constitution of this mineral, three atoms bisilicate of alumina, one atom bisilicate of soda, and two atoms water. Formula: $3\text{AlS}^2+\text{NS}^2+2\text{Aq}$.

Sp. Gr. 2·2 — 2·53. H. = 5·5.

Analcime generally occurs in distinct crystals, either colorless and transparent; or white, grey, red, and opake. The cube is the primary form, there being occasional appearances of cleavage parallel to the planes of that solid; fracture imperfect conchoidal; lustre shining, and between pearly and vitreous. It becomes weakly electric* by friction. Alone on charcoal, B B, it becomes white and opake, and fuses, without intumescence, into a diaphanous glass; with borax is very difficultly soluble. It dissolves in acids, and when reduced to powder, forms a jelly with heated muriatic acid. The solution after separation of the silica gives an abundant precipitate with ammonia.

1.



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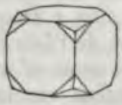

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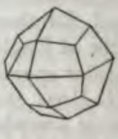
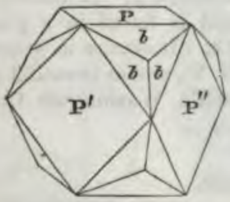


Fig. 1, the primary; a cube. Fig. 2, the same, of which each solid angle is replaced by three planes, thereby adding twenty-four planes to it. Fig. 3. represents the icositetrahedron a crystal on which these twenty-four planes are increased to their utmost extent, so that no part of the primary planes is visible, and forming a solid bounded by twenty-four equal and similar trapeziums.



	Haüy.	
P on P′ or P″ or P′ on P″	90°	00′
P P′ or P″ on *b*	144	44
b on *b*	146	26

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* Whence Analcime, from the Greek, in allusion to the feebleness of this property.

The most perfectly pelucid crystals of this mineral are brought from the Cyclopean Islands, near Catania; they, as well as most of those from the Tyrol, present the above form (the *tri-épointé* of Haüy); while the only crystallization met with in Dunbartonshire, Gleu Farg, and other Scottish localities, is that of fig. 3. These in general are more or less white and opake, occurring in crystals three or four inches in diameter. At the Seisser Alp in the Tyrol, large individuals, extremely similar in appearance, are met with; and in the Faroe Islands, Iceland, several of the Hebrides, the Vicentine, and elsewhere, among the cavities of amygdaloidal, basaltic, and trap rocks, it is of frequent occurrence, associated with prehnite, chabasie, apophyllite, &c. Small crystals have been found in the lava of the Sandwich Islands associated with Gmelinite, according to Dana. In Nova Scotia, trapezohedral analcime abounds in the cavities of the trap rocks which skirt the shores of the Bay of Fundy, and the crystals are sometimes nearly transparent and an inch in diameter; their color varying from pure white to flesh red. They never present any portion of the primary faces; are usually associated with mesotype.

In the United States it is a rarely occurring mineral. It has been found near Yonkers, Westchester County, N. Y., by Prof. Beck, but the only important locality is in the trap rock of Bergen, N. J., where it assumes only the perfect trapezohedral form; as is the case also at Patterson, N. J., where it was discovered a number of years since by Pierce and Torrey. Near East Haven, Ct., it has been found in trap rock, and also very sparingly at Deerfield, Mass., with chabasie and quartz.

Cupreous Analcime. This was discovered by Dr. Jackson and the editor in Nova Scotia, in the cavities of amygdaloid. The crystals have the common form of fig. 3, are of a verdigris-green color externally, but paler towards the centre, and softer than the common variety, consisting of granular particles of composition. They owe their color to the presence of from two to three per cent. of carbonate of copper, pretty uniformly diffused through some of them. In one or two instances, these crystals were found attached to minute filaments of native copper, by which they were thus connected with the rock, or suspended in its cavities.

SODALITE.*

Dodecahedral Zeolite, J. Dodecahedral Kouphone Spar, M. Sodalite, *Haüy*. Vulcanus dodecahedrus, D.

Combination of soda, silica, and alumina, with a small quantity of muriatic acid.

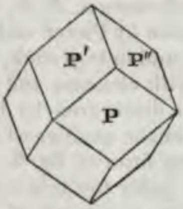
---

* Sodalite, from its containing soda.

	Greenland.	Vesuvius.	Greenland.	Vesuvius.
Soda	25·00	26·55	25·50	20·96
Silica	36·00	35·99	38·52	50·98
Alumina	32·00	32·59	27·48	27·64
Lime	0·00	0·00	2·70	0·00
Muriatic acid	6·75	5·30	3·06	1·29
Protoxide of Iron	0·25	0·00	1·00	0·00
Volatile matter	0·00	0·00	2·10	0·00
	100·00 Eckeberg.	100·43 Arfwed.	100·30 Thom.	100.87 Wachtmeist'r and Berzelius.

Berzelius and Beudant, adopting the last analysis, have given the formula thus: $2AlS+NS^2$. But Dr. Thomson, from the mean of his own analysis and Eckeberg's, deduces two atoms silicate of alumina, and one atom simple silicate of soda; both rejecting muriatic acid.

Its color is white, light green, or bluish-green. It occurs massive, but more often crystallized in rhombic dodecahedrons, parallel to the planes of which it yields to mechanical division: the cross fracture is commonly conchoidal, with a vitreous lustre. It is translucent; and yields with difficulty to the knife. The varieties of this mineral comport themselves differently B B on charcoal; that from Vesuvius, *per se*, suffers no change, except that its edges become rounded; while the Greenland variety melts, with intumescence and a rapid ebullition, into a colorless globule; with borax both varieties afford a diaphanous glass, fusing however in small quantity and with extreme difficulty.



P on P′ or P on P″ or P′ on P″ } 120° 00′

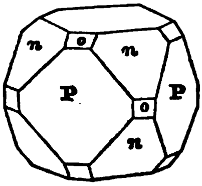
This mineral occurs in white, translucent dodecahedral crystals of considerable magnitude, imbedded in or coating the cavities of certain volcanic rocks, with pyroxene, ice-spar, &c., at Vesuvius; in the Kangerdluarsukfiord, West Greenland, of a green color, both massive and crystallized, associated with eudyalite, augite, and Arfwedsonite; and massive of a grey color, imbedded in trap at the Kaiserstuhl in the Brisgau. The *Cancrinite* of Hoffman, containing soda 24·47, silica 38·40, alumina 32·04, lime 0·32, loss 4·77, is evidently the same mineral. It is fusible in masses of an azure blue-color, presenting six pretty distinct cleavages, which form together angles of 120°. It occurs in the zircon rocks of Miask, near Ilmensee in Siberia.

SARCOLITE.

Octahedral Kouphone Spar, *Haidinger*. Sarcolithe de Thomson, H.

H. about 5·0.

Color pale flesh-red, or brownish-white; semi-transparent; lustre and fracture vitreous; very brittle.



P on *n* . . . . . . 115° 16′

This mineral, from its hardness and vitreous aspect, was classed by Haüy with analcime; but the combination of the octahedron and cube, under which form it occurs, never having been observed in the latter substance, rendered their separation unavoidable. It is found among the anciently ejected debris of Vesuvius, associated with wollastonite, hornblende, and others of the zeolite family; being extremely brittle and full of flaws, it splits and falls to pieces unless carefully handled. It was discovered and named by the late Dr. Thompson of Naples, and is designated by Monticelli, *analcime carnea;* the analysis, however, given both by him and Haüy, refers to Gmelinite.—*Allan's Manual.* Until an analysis of this mineral decides to the contrary, there can be no sufficient reason for separating this mineral from analcime on the ground of a mere difference in the secondary form of its crystals. It is highly important that a genuine specimen of it be subjected to analysis. The name sarcolite has also been given by Vauquelin to the same mineral which is now known as hydrolite or Gmelinite.

OBSIDIAN.*

Obsidian, W. Lave Vitreuse Obsidienne, H. Empyrodox Quartz, M. Fusible Quartz, J. Hyalus Vulcani, D. Pitchstone. Pumice.

	New Spain.	Hecla.	*Marekanite.*	Iceland.
Soda	10·0	1·6	7·00	3·552
Potash		6·0		0·000
Silica	72·0	78·0	77·50	84·000
Alumina	12·5	10·0	11·75	4·640
Oxide of iron	2·0	1·0	1·25	5·012
Lime	0·0	1·0	0·50	2·392
	96·5 Descotils.	97·6 Vauquelin.	98·00 Klaproth.	99·596 Thomson.

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* From Obsidius, the name of the first person who brought it from Ethiopia.

	Pitchstone.		Pitchstone.	
	Meissen.	Newry.	Arran.	Saxony.
Soda	1·75	2·85	6·220	6·320
Silica	73·00	72·80	63·500	73·100
Alumina	14·50	11·50	12·736	13·560
Lime	1·00	1·20	4·460	1·484
Protoxide of iron	1·00	3·03	3·796	0·864
Water	8·50	8·50	8·000	4·724
	99·75 Klaproth.	99·88 Knox.	98·712 Thomson.	100·042 Thomson.

As might be supposed in a non-crystallized mineral, these analyses show no very near approach to a uniform chemical constitution; and the formula, therefore, will not be given.

Sp. Gr. about 2·35. H. $= 6{\cdot}0$.

Obsidian occurs in beds, in large masses, and in small grains; color greenish-, or brownish-black, or smoke-brown; possesses internally a shining vitreous lustre; fracture large conchoidal; some varieties are transparent, others nearly opake, or only translucent on the edges; is very brittle. It occasionally much resembles common glass. Iceland and the Lipari Islands are the most celebrated localities of obsidian; though some remarkable varieties are likewise found in Ascension, Teneriffe, and many of the South Sea Islands, Siberia, and Mexico. The specimens from Iceland are almost opake, exhibiting a brownish tinge only on the thinnest edges, while those from Lipari are more transparent, and of a greyish color. In Lipari the large continuous tracts of obsidian form the lower strata, while those varieties of a more pumaceous aspect occur invariably at a higher level. The purest, blackest, and most beautiful specimens, however, form imbedded nodules in the pumice at a great height, in masses from two inches to as many feet in diameter. Obsidian is frequently interspersed with small white opake globules, which, being formed in parallel lines, give it a stratified appearance; and some of the Lipari specimens closely resemble certain glass-house slags. A variety presenting a silky and chatoyant lustre is found in New Spain; and another of a transparent bottle-green hue, in detached masses, at Moldantheim in Bohemia. It frequently contains imbedded crystals and grains of felspar and mica; and certain varieties also include specks of olivine, and traces of other volcanic minerals.

1. MAREKANITE occurs in the form of grains, of a pearly white, and consisting of thin concentric layers; it is found at Marekan[*] in the Gulf of Kamschatka, and it possesses the general characters of obsidian.

2. PITCHSTONE.[†] Pechstein, W. Petrosilex Resinite, H.

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[*] Whence Marekanite.

[†] From the resemblance of some its varieties to pitch.

The colors of this variety are various shades of grey, blue, green, yellow, brown, and black, but they are not lively. Devoid of regular form or cleavage; it occurs massive, the structure sometimes slaty, occasionally curved; has a glistening resino-vitreous lustre, and an imperfectly conchoidal fracture, which is frequently the chief characteristic distinction between pitchstone and obsidian; almost always opake, or only translucent on the edges. Pitchstone is found extensively in the hills around the valley of Tribisch near Meissen in Saxony; also in the Isle of Arran, where it forms veins traversing granite; and in Ireland, near Newry, County Down, in smooth lamellar concretions of a mountain- or leek-green color. When composed of roundish masses, imbedded in a vesicular matrix, *pearl-stone* is formed; these consist of concentric coats, and not unfrequently include a grain of obsidian. They form extensive beds in Hungary; also in Iceland, Spain, Mexico, and elsewhere.

3. PUMICE. Bimstein, W. Contains soda and potash 3·0, silica 77·5, alumina 17·5, oxide of iron 1·75.

Pumice is extremely porous, of a fibrous texture, and is harsh to the touch; its color is grey, tinged with brown or yellow; it has a shining pearly lustre, is translucent on the edges, and very light. It fuses into a dirty-green blebby glass.

Pumice is frequently interstratified with the compact obsidian at the Lipari Isles. Its usual lightness and freedom from humidity render it a peculiarly suitable building material; sometimes it is fibrous, its filaments having a peculiarly silky aspect; and frequently it presents the most delicate glassy texture, breaking into a million of atoms on the smallest stroke with the hammer. At the northern extremity of the Island of Lipari, it forms a hill eight hundred or one thousand feet in height, which from its peculiar whiteness and scanty herbage is termed Il Campo Bianco. This, and the isles of Ponza, are the great deposits of the pumice known in commerce, and from these localities it is quarried and exported in large quantities; for though by no means an uncommon mineral in other volcanic countries, as in Hungary, the neighborhood of Andernach on the Rhine, Teneriffe, Vesuvius, and Ischia, it occurs at these localities in small cinder-like masses, and is neither so massive nor so pure as at Lipari.

4. SPHÆRULITE. Sphærulite, J. Sphærulith, L. Contains potash and soda 3·58, silica 79·12, alumina 12·0, oxide of iron 2·45, magnesia 1·10, water 1·76.—*Fucinus.*

Sp. Gr. 2·4—2·54. H.$=$6·5—7·0.

Occurs in roundish or spheroidal imbedded masses, whose surface is sometimes rough, sometimes quite smooth; color brown, yellow, or grey; opake; no regular cleavage. It is almost infusible B B, the edges only becoming covered with a sort of enamel.

This variety is met with in round nodules imbedded in pitchstone at Spechtshausen, in Saxony; in radiated orbicular masses in ash-grey pearlstone at Glashutte, near Schemnitz in Hungary; in round balls which have a radiated fibrous structure, disposed in soft friable clay, which is evidently a decomposed rock, in the Shetland Islands; and in botryoidal masses of a bright yellow color in Brittany. It was first distinguished by Breithaupt.

SAUSSURITE.

Prismatic Nephrite Spar, *Haid.* Jade Tenace, H. Nephrus peritomus, D.

Soda	5·50	6·0
Silica	49·00	44·0
Alumina	24·00	30·0
Lime	10·00	4·0
Magnesia	3·75	0·0
Oxide of iron	6·50	12·5
	99·55 Klaproth.	100·5 Saussure.

Sp. Gr. 3·2 — 3·4. H. = 5·5.

In masses of a greenish-white, mountain-green, or ash-grey color; lustre pearly, inclining to vitreous on the faces of cleavage; resinous in compound varieties; cleavage in two directions, parallel to faces which meet at an angle of 120° nearly; is translucent on the edges, unctuous to the touch, and extremely tough. B B it fuses with difficulty into a white glass.

It was first discovered by Saussure,[*] in rounded masses, on the edge of the lake of Geneva; it is pecular to primitive mountains, as in Corsica, in Greenland, at Madras, and elsewhere, constituting, with augite and hornblende, the rocks called gabbro and euphotide.

SCAPOLITE.[†] MEIONITE.[‡]

Scapolith, W. Prysmato-pyramidal Felspar, J. Dipyre. Meionite, W. H. Paranthine, Wernerite, H. Pyramidal Felspar, M. Spatum quadratum, D.

Combination of silica, alumina, lime and soda.

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[*] In honor of whom it is named.

[†] From the prismatic form of its crystals.

[‡] From μειων, *less*, so named from the lowness of the pyramid with which the crystal is usually terminated.

	Peranthine. Pargas.	*Scapolite.* Finland.	*Scapolite.* Bolton, Mass.
Silica	43·83	41·25	46·30
Alumina	35·43	33·58	26·48
Lime	18·96	20·36	18·63
Soda and Lithia	0·00	1·50	3·64
Water	1·03	3·32	5·04
	99·28 Nordenskiöld.	99·05 Nordenskiöld.	100·06 Thomson.

	Meionite. Vesuvius.	*Meionite.* Monte Soma.	*Meionite.* Tyrol.
Silica	40·8	40·53	39·92
Alumina	30·6	32·72	31·97
Lime	22·1	24·24	21·86
Soda and Lithia	2·4	0·00	0·00
Potash and Soda	0·0	1·81	0·89
Peroxide of iron	1·0	0·18	2·24
Protoxide of manganese	0·0	0·00	0·17
Water	0·0	0·00	0·95
	100·0 Gmelin.	99 48 Stromeyer.	100·00 Stromeyer.

Beudant, who has not united scapolite and meionite as one species, gives for the formula of the first $3AlS+CalS$; and for the last $2AlS+CalS$. But the identity of these minerals is now fully established, physically and crystallographically, and taking the mean of several of the most accurate analyses which have hitherto been made, and which are above stated, the atoms of bases will be found equal to those of silica, and the atoms of alumina to be twice those of lime. Hence the constitution of both minerals is expressed by the same formula which Beudant has given for meionite, viz., $2AlS+CalS$. It is obvious that the other constituents are not essentially combined.

Sp. Gr. 2·5—2·7. H = 5·0—5·5.*

Scapolite occurs in prisms of four or eight sides, sometimes terminated by tetrahedral pyramids; they are often aggregated laterally. It also occurs massive. The primary form is a Right square prism, and it yields to cleavage parallel to the planes M M′, and interruptedly parallel with *d*, of the following figures. Its colors are white, grey or yellowish; sometimes deep red and opake; or various shades of green. It has a shining or somewhat pearly lustre; is translucent, or nearly transparent; and generally presents a greenish color, either pale and somewhat translucent, or dark, and then the crystals are nearly opake. B B, on charcoal, with a strong heat, it fuses, with violent intumescence, into a colorless semi-transparent mass; with borax it dissolves with effervescence, into a transparent glass.

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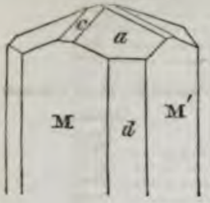
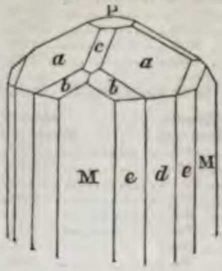
* Dana found the hardness of a nearly transparent variety from Gouverneur, N. Y., to be 5·5, nearly 6, and its specific gravity 2·612—2·749.

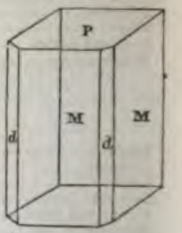
1.
Pargas, Finland.



2.
Meionite. Vesuvius.



3.
New York.



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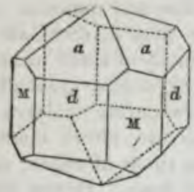
New York.



M on M or P on M or M	90°	0′
M on *d*	135	2
—— *e*	153	24
d on *e*	161	35
a on *d*	122	5
M on *a*	112	5
a on *a*	136	22 H.
M on *b*	140	18
a on *b*	151	31

Scapolite occurs in primitive mountains, being met with in the iron mines of Arendal, in gneiss; in the mining district of Wermeland in Sweden; presenting large and beautiful crystals in the parish of Pargas in Finland; at Akudlek in Greenland, &c. Meionite is found principally at Vesuvius, in distinct crystals imbedded with other volcanic minerals in the débris of ancient eruptions. The pure white and nearly transparent varieties, wherever they occur, are properly included under the name meionite.

Scapolite is an abundant mineral in the United States. The white crystalline limestone of Essex, Orange, Lewis, and St. Lawrence Counties, N. Y., have afforded the finest crystals.* The prisms are from three to five inches in length, but these are generally imperfect, while the smaller ones are often pure white, translucent to semi-transparent, and possess a high degree of perfection and finish. At Edenville, Orange county, the form nearly approaches the primary, the only replacements being on two lateral edges of the prism by tangent planes, fig. 3. Near Gouverneur, St. Lawrence County, very short prisms resembling the *dioctaèdre of Haüy*, fig. 4, have been met with. They are associated with apatite, sphene, and pyroxene. At Bolton and Boxborough, Mass., large crystals, but usually without regular terminations, occur in veins of quartz which traverse the white limestone. A beautiful pink and lilac colored variety of a laminated crystalline structure, and forming considerable masses, may be also obtained at the last named locality; but more abundantly in the neighboring town of Littleton. A compact variety occurs at Westfield, Mass., and a fibrous one at Monroe, Conn. In Bucks County, Penn., in the lime stone quarries, it is found both crystallized and massive, associated with table-spar, zircon and phosphate of lime.

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* Numerous secondary forms, from these localities, have been figured by Prof. Beck and Dr. Horton. See Mineralogy of New York, page 330, *et seq.*

1. **Wernerite.** The variety termed Wernerite occurs principally at Arendal, in short thick crystals which have a granular composition, and present for the most part darker shades of color; beautiful specimens are also brought from Greenland. *Paranthine*, including the most compact varieties, possess pure white and pale-blue colors, and is met with in the limestone quarries of Gulsjoö and Malsjö in Wermeland.

2. **Bergmannite** of Schumacher, from Stavern in Norway. It occurs massive, and of a greyish-white or brick-red color. It is supposed to be a variety of scapolite.

3. **Dipyre**[*] of Haüy, Schmelztein of Werner. It occurs in slender indistinctly formed prisms, of a greyish, or reddish-white color, fasciculated into masses; and has also been observed in the form of a hexahedral prism terminated by a low pyramid. Lustre vitreous; translucent; hard enough to scratch glass; and becomes slightly phosphorescent by the application of heat. B B it fuses with effervescence into a blebby colorless glass. It is found in the torrent of Mauléon, in the Western Pyrenees, imbedded in a kind of soft slate

4. **Ekebergite**, *Berzelius*. Sodaite, *Ekeberg*. The following description of this mineral is given by Necker. It is not found crystallized, but occurs in compact or finely fibrous masses, of a green, greyish, or brownish color; occasionally in thin laminæ. Transparent; lustre vitreous or resinous; with difficulty acted upon by acids. B B, in the matrass, it yields a little water, without altering its appearance; on charcoal it whitens, loses its transparency, intumesces slightly, and melts into a blebby colorless glass. In borax or salt of phosphorus it fuses with effervescence; and in soda forms, with considerable difficulty, a greenish glass.

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[*] Dipyre, from the Greek, signifying the double effects of fire, in allusion to its phosphorescence and fusibility by heat.

Its analysis gave Ekeberg, silica 46, alumina 28·75, lime 13·50, soda 5·25, oxide of iron 0·75, water 2·25.

PEKTOLITE.

Von Kobell. (*Kastner's Archiv.*, xiii., 385.)

Silica	51·30
Lime	33·77
Soda	8·26
Potash	1·57
Water	3·89
Alumina and oxide of iron	0·90
	99·69 Kobell.

Formula, as given by Beudant: $4\text{CalS}^2+(\text{K},\text{N})\text{S}^3+3\text{Aq}$.
Sp. Gr. 2·69. H. = 4·0 — 5·0.

Occurs in spheroidal masses, which have a columnar composition, and consist of delicate divergent fibres radiating from a centre; color greyish; surface generally dull; opake; lustre pearly on the fracture; small fragments placed in muriatic acid, after several days are converted into a jelly; yields easily a white translucent glass when exposed to the action of the blowpipe.

It bears considerable resemblance to certain fibrous radiated varieties of mesotype. It forms large masses on Monte Baldo in the Southern Tyrol, and at Monzoni in the Fassa-thal.

CHABASIE.*

Schabasit, W. Chabasie, H. Rhombohedral Zeolite, J. Rhombohedral Kouphone Spar, M. Vulcanus rhombohedrus, D

Combination of silica, alumina, lime, and water, with a little soda and potash.

	Gustafsberg.	Faroe.	Kilmalcolm.	Antrim.
Silica	50·65	48·38	50·14	48·99
Alumina	17·90	19·28	17·48	19·77
Lime	9·73	8·70	8·47	4·01
Soda	0·00	0·00	0·00	6·06
Potash and soda	1·70	2·50	2·58	0·00
Water	19·50	21·40	20·83	20·70
	99·48 Berzelius.†	100·20 Arfwedson.	99·50 Connell.	99·53 Lehunt.

	Colorless crystals. Kilmalcolm.	Biebendörfel. Bohemia.	Tyrol.	Faroe.
Silica	48·75	48·18	48·63	47·25
Alumina	17·44	19·27	19·52	20·85
Lime	10·47	9·65	10·22	5·74
Potash	1·55	0·21	0·28	1·65
Soda	0·00	1·54	0·56	2·34
Water	21·72	21·10	20·70	21·30
	99·93 Thomson.	99·95 Hoffman.	99·91 Hoffman.	99·63 M. Durocher.‡

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* From the Greek, signifying a particular species of stone. It was first named and described by Box d'Antic, in a memoir read to the Nat. Hist. Soc. of Paris, about the year, 1780.

† The excess of silica in this analysis, is attributed by Berzelius to the quartz on which the crystals rested. Edinb. Phil. Jour. vii., p. 2.

‡ Ann. des Mines, 1841, t. xix., p. 457. This result differs considerably from all the others, even from the specimen analyzed by Arfwedson from the same place, and it comes much nearer to the composition of Levyne.

	Acadialite.[*]	Acadialite.[†]	Acadialite.[‡]	Acadialite.[§]
Silica	52·02	51·46	52·40	52·20
Alumina	17·88	17·65	12·40	18·27
Lime	4·24	8·91	11·60	6·58
Potash	3·03	0·17	0·00	2·12
Soda	4·07	1·09	0·00	
Peroxide of iron	0·00	0·85	2·40	0·00
Water	18·30	19·66	21·60	20·52
	99·60 A. A. Hayes.	99·79 Hoffman.	100·40 Thomson.	99·69 A.A. Hayes.

The formula which has been given by Arfwedson and Connell to express the constitution of chabasie, and which we obtain from the first seven analyses before stated, is, $3AlS^2+(Cal, N, K,)S^2+6Aq$. In the second analysis of the chabasie from Nova Scotia, by Hoffman, there was found an excess of silica, which excluded it from the common formula, while in other respects it conformed to it. This induced Hoffman to regard it as distinct from chabasie.[||] Subsequent examinations have proved this excess to be constant, and instead of bisilicate of lime and alkalies, as associated in common chabasie, we now have a tersilicate of these bases. In the specimens of Acadialite from different localities in Nova Scotia, the potash and soda replace variable proportions of the lime; but in the specimen analyzed by Dr. Thomson, there is neither potash nor soda, and a notable deficiency in alumina, which, however, is partly made up by the oxide of iron. The formula for Acadialite, is, therefore, thus stated: $3AlS^2+(Cal, N, K,)S^3+6Aq$.

Sp. Gr. 2·0 — 2·1. H. = 4·0 — 4·5.

This mineral is found crystallized in the form of an Obtuse rhomboid of 94° 46′ and 85° 14′, by measurements on the planes of cleavage with the reflective goniometer; it yields to cleavage parallel to the planes of the rhomboid, occasionally with brilliant surfaces. Color white or greyish, sometimes pale-red, brick-red, and yellow; transparent or translucent; scarcely hard enough to scratch glass. Fracture uneven; brittle. Lustre highly vitreous. Alone it melts easily B B, into a spongy-like white enamel. Is easily soluble in muriatic acid.

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[*] Colorless, and nearly transparent crystals from Swan's Creek, Basin of Mines, Nova Scotia.

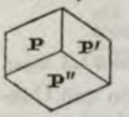
[†] Brick-red hemitrope crystals, (Sp. Gr. 2·075,) Parsboro', Nova Scotia. Selected by Charles Cramer, Esq., of St. Petersburg. See Poggendorf's Annalen 1832, No. 7.

[‡] Yellowish crystals, (Sp. Gr. 2·020), Partridge Island, Nova Scotia. See Lond. Edinb. and Dub. Phil. Mag., 1843, vol. xxii., p. 192.

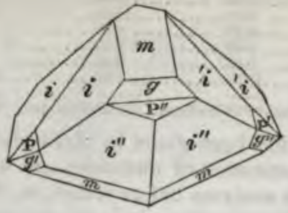
[§] Reddish brown crystals, opposite Two Islands, Nova Scotia. The specimens analyzed by Dr. Thomson and Mr. Hayes, were selected for these gentlemen by the editor, and the results of the latter were not made public until they appeared in this work.

[||] See his paper in vol. xxx., p. 366, of the American Journal of Science, copied from Poggendorf's Annalen.

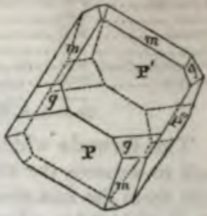
Primary



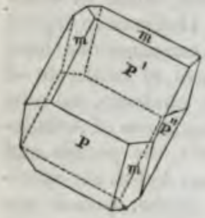
1.
Oberstein.



2.
Nova Scotia.



3.
Nova Scotia.



P on P′	94°	46′
P or P′ on P″	85	14
P ou g', P″ on g, or P′ on g'' .	120	5
P on i or i P′ on i' or i' P″ on i'' or i''	175	30
i on i, i' on i', or i'' on i''	173	32
g on m	143	59 H.

Chabasie is met with in the fissures or cavities of some basaltic rocks, or within geodes of quartz or agate, which are disseminated in those rocks. It is thus found in large and very beautiful crystals in the amygdaloids of Faroe, Iceland, and Greenland, often associated with stilbite and green earth. Splendid specimens occur in a kind of greenstone rock (the *graustein* of Werner) at Aussig in Bohemia. Smaller but more transparent varieties are met with in the basalt of the Giant's Causeway; disposed on trap and accompanying stilbite at Kilmalcolm in Renfrewshire, where they are sometimes of a reddish color; in the Isle of Skye, and elsewhere in the west of Scotland; also at Gustafsberg in Sweden; in the agate balls of Oberstein in Deuxponts; and at Husavic in Iceland, in small transparent crystals filling the cavities of the fossil Venus Islandica. It does not occur massive.

The trap rocks of the United States have furnished several localities of this mineral, as at Deerfield, Mass., Farmington and Cheshire, Conn., where it is accompanied by prehnite. But the crystals are inferior in beauty and size to those from foreign localities, and they rarely present any modifications. The finest have been obtained at Bergen, N. J., where they are associated with apophyllite, stilbite and calc-spar. At Chester, Mass., and Hadlym, Conn., it occurs in mica slate. At West Farms, West Chester County, N. Y., and at Harlem, near New York city, it is associated with stilbite and Heulandite. At the latter place its color is yellow or brownish-red. Crystals having the same color have also been found at Stonington, and others of a yellowish-white color at North Killingworth, Conn., in primitive rock, by Prof. Shepard. The sienite of Charlestown, Mass., has also furnished many very good specimens of the colorless variety.

Acadialite. This variety of chabasie, if such it is to be considered, is found in the trap rocks of Nova Scotia. The principal locality is on the northern shore of the Basin of Mines. The crystals are of variable color, but usually wine-yellow, or flesh red, and present highly polished faces sometimes more than an inch in length. They are more or less modified on their superior edges, and lateral solid angles, by single planes, and not unfrequently united in hemitropes. Fig. 2 is one of the commonest secondary forms of this mineral from Nova Scotia. Sometimes the solid angles alone are replaced, as are also very rarely the terminal edges, as in fig. 3.[*] Faces of the primary planes much curved and striated, so as to prevent the accurate use of the goniometer. But according to Prof. G. Rose, the acadialite offers no variation in its angles compared with common chabasie. Tamnau had supposed it probable that the variations in the angles of chabasie, as given by different authors, were owing to changes in the chemical composition of the mineral. The result by Prof. G. Rose, seems to show that this is not the case to any appreciable extent, even where there is the greatest difference in composition.[†]

CAPORCIANITE.

This substance was first observed by Dr. Paolo Savi at Caporciani, in the valley of the Cæcino, where it occurs in a copper mine, and has been described by him in his *Memorie per servire allo studio della costituzione fisica della Toscana.* It evidently belongs to the class of zeolites, and it conducts itself perfectly similar to the other zeolites in so far as its friability and relation to fluxes are concerned; but, according to Dr. Anderson, who has examined and analyzed this mineral,[‡] it differs from them in this much, that, previous to melting, it swells out only to a very inconsiderable degree; for it melts almost at the same instant that the swelling manifests itself. Its analysis yielded the following results:

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[*] I give this figure on the authority of Dr. Tamnau, of Berlin, for I have never seen a crystal from Nova Scotia, which exactly represents this modification. [Am. Ed.]

[†] See the valuable "Monograph on Chabasie," by Dr. Tamnau of Berlin, in which he has given figures of all the occurring forms of this mineral, and stated its most important localities. [Am. Ed.]

[‡] Trans. of the Roy. Soc. of Edinb., vol. xv., part 2, p. 332.

Silica	52·8	
Alumina	21·7	
Peroxide of iron	0·1	
Soda	0·2	r.
Lime	11·3	
Magnesia	0·4	
Potash	1·1	
Water	13·1	= 100·7,

The monatomic bases being expressed by r, Dr Anderson, from the contained oxygen, determined the formula thus, (r, Al, S, and Aq, being to each other as 1:3:8:3)—rS^2+3AlS^2+3Aq. Rammelsberg has given a somewhat different formula.

Caporcianite thus stands chemically in near relation with analcime, chabasie, and Levyne, from which it is separated merely by the difference in the quantity of water which it contains. They all consist of a bisilicate of the first as well as of the second term; and the quantity of oxygen in the alumina is in all of them three times that contained in the monatomic basis.

It occurs in masses composed of crooked fibres of a greyish red color, but the crystallographical, as well as the ordinary physical characters of this mineral, have not been given in the single notice which the editor has seen of it, and he has not been able to obtain the work here referred to, in which, it is presumed, they are stated at length.

PHAKOLITE.

This mineral occurs in small crystals in the Bohemian Mittelgebirge, and has been usually supposed to be nearly allied to chabasie, having for its primary form a Rhomboid differing but a few minutes in its angles compared with that of chabasie; one being 94°, and the other 94° 24′, according to Breithaupt, who supposes the phakolite to be a distinct species. Tamnau has referred us to three figures in his Monograph on chabasie, which perfectly represent the forms of phakolite, and he seems to have no hesitation in classing it with chabasie. In its characters, B B, and its physical relations generally, there is also a close resemblance between the two minerals. But in opposition to this view, we are now presented with an analysis of the mineral by Dr. Anderson of Edinburgh, and also by M. Rammelsberg,* showing a very marked disagreement in their chemical constitution. They have given the following results:

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* Trans. of the Roy. Soc. of Edinb., vol. xv., part 2, p. 333. Rammelsberg's Handwörterbuch des chemischer Theils der Mineralogie, (First Supplement), p. 112.

Silica	45·628		46·46
Alumina	19·480		21·45
Peroxide of iron	0·431		
Soda	1·684	r.	0·95
Lime	13·304		10·45
Magnesia	0·143		0·00
Potash	1·314		1·29
Water	17·976 = 99·960. Anderson.		19·40 = 100·00. Rammelsberg.

The mineralogical formula obtained from these numbers by calculating the quantities of oxygen, is thus stated by Dr. Anderson, (r expressing the monatomic bases, Cal, Mg, K, N), $rS^3+2AlS+3Aq$.

It appears then, that, unlike chabasie, phakolite belongs to that class of hydrous trappean minerals, which consist of a tersilicate in the first term, as here expressed, and in the second of a simple silicate of the base along with water. It thus bears a much nearer resemblance to mesotype and mesolite, though none in crystalline form. This mineral, according to Dr. Thomson, has lately been found in Ireland.

Rammelsberg, from his own analysis, is disposed to regard this mineral as a mixture of Acadialite and scolezite with an additional atom of water. (See *First Supplement* to his *Handwörterbuch*, p. 112.

LEVYNE.

Macrotypous Kouphone Spar, M. Levyne, *Brewster*, (*Edinb. Jour. of Sci.*, ii., 332.) *Connell*, (*Ibid*, v. 332.) Vulcanus Levyanus, D.

Combination of silica, alumina, lime, and water, with a little soda and potash.

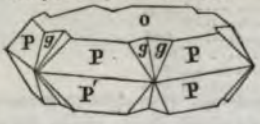
	Antrim.	Faroe.	Antrim.
Silica	44·75	48·00	46·30
Alumina	20·33	20·00	22·47
Lime	8·83	8·35	9·72
Soda	3·33	2·75	1·55
Potash	0·00	0·41	1·26
Oxide of iron	0·00	0·00	0·77
Magnesin	0·77	0·40	0·00
Oxide of manganese	0·00	0·00	0·19
Water	20·00	19·30	19·51
	98·04 Thomson.	99·21 Berzelius.	101·77 Connell.

The formula indicating the composition of this from the last analysis, as stated by Connell is, $S(Cal, N, K)+3AlS^2+5Aq$. It thus differs from chabasie in containing one atom less of silica, and one atom less of water; and from Acadialite in containing two atoms less of silica.

Sp. Gr. 2·198—2·2. H. = 4·0.

Primary form a Rhomboid of 79° 29′. The color of this species is white, or milk white. Semi-transparent; lustre vitreous; streak white; cleavage indistinct, parallel to the faces of the primary; fracture imperfect conchoidal; brittle.

Compound crystal from Faroe.



P on P′	125°	12′
o on *g*	136	1
o on P	117	24

Upon charcoal it intumesces, and with salt of phosphorus yields a transparent globule, which contains a skeleton of silica, and becomes opake on cooling. In the glass tube it gives off a considerable quantity of water, whitens, and becomes opake; but it is not soluble in acids, nor does it gelatinize with them.

Sir David Brewster subjected this mineral to optical examination, and named it in compliment to Mr. Levy, who had previously examined its crystallographic properties. He has shown its character in this respect to be different from chabasie, thus affording with the crystallographical differences observed by Haidinger, evidence of its distinct nature compared with chabasie. This evidence is now confirmed by the analysis of Connell.* It occurs disposed in cavities of trap, associated with acicular and radiated mesotype, at the Little Deerpark of Glenarm, county Antrim; also at Skagastrand in Iceland; at Dalsnypen in Faroe; Godhaven in Disco Island, Greenland; in the Vicentine; and, though rarely, in large reddish colored opake crystals at Hartfield Moss in Renfrewshire. Mr. Connell has also found it in the Isle of Skye.

TOURMALINE.

Tourmalin, W. Schorl, Br. Rhomboidal Tourmaline, J. Rhombohedral Tourmaline, M. Aphrizite. Rubellite. Indicolite. Turmalus rhombohedrus, D.

Combination of silica, alumina, oxide of iron, and lime, with small proportions of magnesia, potash, soda and boracic acid.

	Black.† Rabenstein.	*Brown.* St. Gothard.	*Black.* Karinbricka.	*Black.* Greenland.	*Brown.* Orford. N.H
Soda	1·75	1·20	2·53	3·15	4·90
Potash	0·48			0·22	
Silica	35·48	37·81	37·65	38·79	33·70
Alumina	34·75	31·61	33·46	37·19	33·00
Protoxide of iron	17·44	17·77	9·38	5·81	11·80
Protoxide of manganese	1·89	1·11	0·00	0·00	3·00
Boracic acid	4·02	4·18	3·83	3·63	3·10
Magnesia	4·68	5·99	10·98	5·86	6·40
Lime	0·00	0·98	0·25 . . loss	1·86	2·90
	100·49	100·65	98·11	96·51	99·00

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* Berzelius was led by his own analysis, as above stated, to regard this mineral as chabasie; but it has been since ascertained that the specimen sent to him was a mixture of both minerals, and it is inferred that crystals of both were employed in his analysis. [Am. Ed.]

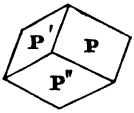
† The first four of the above analyses are by Gmelin. Ann. des Mines, s. s., iii., p. 218. The fifth analysis is by Dr. Jackson.

The composition of this mineral, as comprising the black, green, brown, red, and blue varieties, differs so much, that chemists have not attempted to express it by a formula. Boracic acid is contained in all these varieties, and lithia in rubellite.

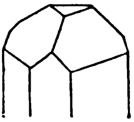
Sp. Gr. 3·0 — 3·2. H. = 7·0 — 7·5.

It occurs both in semi-crystalline prisms of irregular form and deeply striated on the surface, and in prisms of six or more sides, variously terminated, the two terminations being generally dissimilar. Sometimes these prisms are extremely short and thick, and at others are acicular or even capillary. Its color is usually black, dark-green, or brown; the latter being generally translucent in one direction and opake in the other, the black altogether opake; externally the crystals are splendent. The primary form is considered to be an Obtuse rhomboid of 133° 50′, and 46° 10′. Cleavage and fracture uneven and imperfect. It is not so hard as quartz. One of its remarkable characters is, that it becomes electric when heated; the termination which presented the greatest number of planes, was supposed by Haüy to exhibit in all cases the positive or vitreous electricity, while that which consisted of the smaller number, indicated the negative or resinous — an inference, however, which more recent experiments have proved not to be uniformly true.* B B, the black tourmaline of Bovey intumesces, and becomes a black scoriaceous mass; with borax it fuses into a transparent glass. Fused with a mixture of fluor spar and bisulphate of potash, it communicates to the flame a transient green color.†

1.



2.



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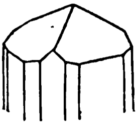

Fig. 1 represents the primary rhomboid, of which the summit is replaced by a triangular plane in fig. 2, as well as each lateral solid angle, by planes which form the ordinary six-sided prism of this mineral; the edges of the prism are modified in fig. 3.

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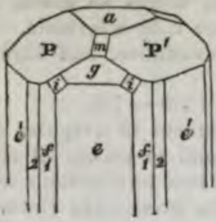
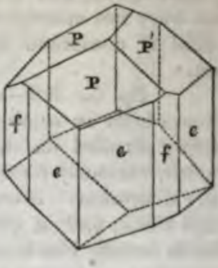
* The phenomena of the pyro-electricity of minerals, have lately been investigated by Prof. Forbes of Edinburgh, and many important results have been obtained by him, extending to several other minerals the remarkable law of Becquerel, that the intensity of electricity rises to a maximum, when the speed of cooling has become comparatively low. He has noticed the singular fact, that a crystal of tourmaline presented on cooling a vitreous pole at both extremities, while the central portions of it were resinously electrified. Trans. Roy. Soc., Edinb. vol. xiii. [Am. Ed.]

† The color is most distinctly seen when the mixed flux of fluorspar and bisulphate of potash is fused on the platinum wire, and a little of the mineral in the state of fine

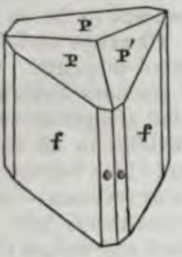
1.



2.
Monroe, Ct.



3.
Haddam, Ct.



P on P′	133°	50′
P or P′ on *m*	156	50
——— on *g*	141	10
P on *i* or P′ on *i*	138	7
P or P on *e*	117	25
e on *e*′ or *e*″	120	00
e on *f* 1	149	30
f 1 on *f* 2	155	25
e on *i* or *i*′	147	32
e on *g*	136	15
a on *e*	90	00 *c. g.*
m on *e*	103	30 *c. g.*

Tourmaline is confined to primitive rocks, such as gneiss, granite, mica-schiste, &c., and to the veins which traverse these rocks. The largest and most striking black crystals occur in Greenland; at Hörlberg near Bodenmais in Bavaria; at Karinbricka in Sweden; and near Bovey in Devonshire, coating the cavities of red granite and associated with apatite; small brilliant black crystals, having much the aspect of tin ore, are met with imbedded in white quartz in Norway, at St. Just in Cornwall, and in decomposed felspar at Andreasberg in the Hartz; these are known as *Aphrizite.* Large curved crystalline prisms occur in granite at Portsoy in Banffshire; also in Norway, Saltzburg, the Tyrol, and Saxony,—the name *Schorl,* which is applied to this variety, being derived from the village of Schorlan in the latter country.

Tourmaline is also met with in pale yellowish-brown crystals imbedded in talc at Windisch Kappel in Carinthia; in pale-green translucent crystals in dolomite at St. Gothard; of a dark pistachio-green color in Brazil; and nearly pure white

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powder is then strewed on the surface of the melted flux. A good and clear flame is necessary. The color is observed at the moment when the mineral begins to fuse with the flux.—Von Kobell.

in Siberia and Switzerland. In Elba the crystals, when transparent, frequently exhibit parallel zones of distinctly different colors, being red at the two extremes, and dark-blue in the centre, or partly grass-green and partly azure-blue, &c. Tourmaline possesses the singular property of exhibiting different colors according as it is viewed parallel or perpendicular to the axis of its crystals, and almost invariably is less transparent in the first of these directions than in the last.

In the United States, a rare clove-brown tourmaline occurs in talcose slate at Orford, N. H., crystallized specimens of which are more than two inches in diameter and six inches in length, sometimes with perfect terminations. Also a radiated variety of the same color is abundant at this locality. Its analysis by Dr. Jackson is given at the beginning of this article. The common black variety has numerous localities, a few only of which will be named, as at Richmond and Lyme, N. H., in white quartz and talcose slate, the crystals being regularly terminated; at Paris and Brunswick, Me., Monroe and Haddam, Conn., Greenfield, N. Y., and Chester, Delaware County, Penn., — where the crystals possess highly polished surfaces, and are of considerable magnitude. Two of these crystals are shown on the opposite page; for others consult the treatises by Dana, Shepard and Beck. The red and green varieties have been found at Paris, Me., and Chesterfield and Goshen, Mass. Specimens from the former place are celebrated for their gem-like purity — the outer portion often consisting of a deep green tourmaline enclosing a transparent rubellite, some of the crystals being two inches in length, and an inch in diameter. Specimens from Chesterfield are similarly united, but they are small and exceedingly brittle. They penetrate a smoky quartz, and are accompanied by Cleavelandite, in a vein of granite traversing gneiss. The blue variety (*indicolite*) occurs in the greatest perfection at Goshen; less beautiful at Paris. A cinnamon-brown variety occurs at Gouverneur, N. Y., in crystals which are highly modified; also at Newton, N. J., and Carlisle, Mass.

1. INDICOLITE. Tourmaline d'Uto. Blue tourmaline containing more oxide of iron than oxide of manganese. Silica 40·30, alumina 40·50, boracic acid 1·10, oxide of iron 4·85, oxide of manganese 1·50, Lithia 4·30, water 3·60. — *Arfwedson*. In crystals of an indeterminate form and presenting an indigo-blue color (hence its name). Alone B B it whitens, intumesces slightly, and becomes scoriaceous on the surface, but does not melt. With borax it fuses with effervescence, but more difficultly than rubellite.

Its principal locality is the iron mine of the island of Uton near Stockholm, where it occurs disseminated in a gangue of quartz, steatite, and felspar.

2. Green Tourmaline. This variety from Brazil, and a specimen from Chesterfield, Mass., yielded the following:

	Brazil.	Chesterfield.
Silica	40·00	38·80
Alumina	39·16	39·61
Lithia and Potash	3·59	0·00
Soda	0·00	4·95
Protoxide of iron	5·96	7·43
Protoxide of manganese	2·14	2·88
Boracic acid	4·59	3·88
Volatile matter	1·58	1·02
	97·02 Gmelin.	98·57 Gmelin.

3. Rubellite. Siberite. Tourmaline Apyre, H. Apyrite. Tourmaline rouge. Tourmaline containing more oxide of manganese than oxide of iron. Sp. Gr. 3·059.

	Moravia.	Siberia.
Silica	42·13	39·37
Alumina	36·43	44·00
Boracic acid	5·74	4·18
Oxide of manganese	6·32	5·02
Lime	1·20	0·00
Potash	2·41	1·29
Lithia	2·04	2·52
	96·27 Gmelin.	97·96 Gmelin.

The rubellite presents various shades of red, from a slight tinge to a fine pink, and sometimes a violet color. Its crystals are rarely distinct, being commonly closely aggregated. Alone on charcoal, B B, it turns milk-white, intumesces, splits, vitrifies on the edges, but does not fuse; with borax it forms a transparent glass; on platina, with soda, it exhibits to an intense degree the green color indicative of manganese. It occurs imbedded in lithomarge near Ekatherineburg in Siberia; and accompanying lepidolite at Rozena in Moravia. Some of the Siberian specimens exhibit internally a brown or blue color, surrounded with carmine-red or some other lighter tinge, or internally a red hue bordered with pistachio-green.

EDINGTONITE.

Hemi-pyramidal Feldspar, *Haidinger.** Vulcanus hemiquadratus, D.

According to Turner, it contains silica 35·09, alumina 27·69, lime 12·68, water 13·32, and, as he supposes, about 10 or 12 per cent. of alkali.

Sp. Gr. 2·7 — 2·75. H. = 4·0 — 4·5.

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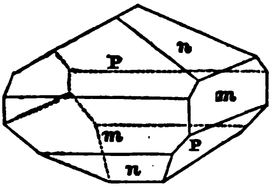
* Brewster's Edin. Jour. of Sci., vol. iii., p. 376.



n on *n* over the summit . . 129° 8′

P on P over *n* and *n* 92 41

Occurs in small extremely distinct greyish-white translucent crystals, whose primary form, according to Hadinger, is a Right square prism. The secondary form under which it occurs is a hemihedral crystal, the upper and lower basal edges of the same lateral face being differently modified. Lustre vitreous; streak white; brittle. Cleavage perfect parallel to the lateral planes. B B it fuses into a colorless mass, though a pretty strong heat is necessary for that purpose. It yields water when exposed to high temperatures, and becomes at the same time opake and white.

Edingtonite was remarked by Haidinger on a specimen of Thomsonite from Dunbartonshire, in the collection of Mr. Edington of Glasgow. Its peculiar crystalline form, specific gravity, and hardness, are sufficiently characteristic, although from its extreme scarcity a satisfactory analysis has not yet been made.

KROKYDOLITE.*

Krokydolite, *Hausman.* Blau Eisenstein, *Klaproth.* Siderus fibrosus, D.

Of this there are two varieties; one like asbestus, the other fibrous; neither being in distinct crystals.

	Asbestus.	*Fibrous.*
Contains Soda	7·03	7·11
Silica	50·81	51·64
Protoxide of iron	33·88	34·38
Oxide of manganese	0·17	0·02
Magnesia	2·32	2·62
Water	5·58	4·01
Lime	0·02	0·05
	99·81 Stromeyer.	99·85 Stromeyer.

Sp. Gr. 3·2 — 3·39. H. above 4·0.

Color lavender- or indigo-blue; streak lavender-blue or leek-green. Occurs in fibrous masses which are flexible and elastic like asbestus, and compact; opake; lustre silky; not magnetic; not affected by water or acids. It resembles asbestus; but is distinguished from it by the melting of its fibres when held in the flame of a spirit lamp. The mineral itself melts before a strong red heat into a black opake magnetic globule. With borax it forms easily a transparent green-colored glass.

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* From κροκυς, like wool, on account of its divisibility into minute threads.

Its locality is the Orange River in Southern Africa. It was first described by Haussman and Stromeyer in 1830.

ACHMITE.*

Acmite, Akmit, *Haidinger*. Achmit, *Stromeyer*. (*Edinb. Phil. Jour.*, ix., 55.) Augitus cuspidatus, D.

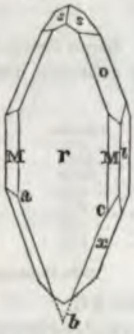
Combination of soda, silica, and peroxide of iron.

Silica	55·25
Soda	10·40
Oxide of iron	31·25
Oxide of manganese	1·08
Lime	0·72
	98·70 Berzelius.

Formula: $3FS^2+NS^3$. The analysis by Lehunt, gives only two atoms bisilicate of iron.

Sp. Gr. 3·5. H. = 6·0 — 6·5.

Primary form an Oblique rhombic prism of 86° 57′, and 93° 3′. Opake; when in thin fragments translucent, and exhibiting a yellowish-brown tint; lustre vitreous; streak pale yellowish-grey; cleavage distinct parallel to M, less so parallel to *r*, *l*, and *s*; fracture imperfect conchoidal; surface of r irregularly striated longitudinally.



M on M over *r*	86°	56′
s on *s*	119	30
edge between *s* and *s* to the face *r*	106	0
the angle *a b c*	28	19

Frequently macled parallel to *r*. Alone, B B, achmite fuses readily into a brilliant black globule; with borax forms a glass colored by iron; and when reduced to powder is acted upon by the sulphuric and muriatic acids.

This is a rare mineral, its only known locality being Run-

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[*] From *ακμη*, *a point*, from the form of its crystals.

demyr, near Kongsberg, in Norway. It there occurs in crystals sometimes a foot long, imbedded in granite, which, however, from their frangibility, are not easily disengaged entire. It was described by Stromeyer and analyzed by Berzelius in 1821.

CUMMINGTONITE.

Dr. Thomson. (*Outlines, &c.*, i., p. 492.) Augitus scopiformis, D.

Contains Soda	8·44
Silica	56·54
Protoxide of Iron	21·67
Protoxide of manganese	7·80
Loss from heat	3·18
	97·63 Muir.

Formula by Dr. Thomson: $3\underline{F}S + NS^3 + \underline{M}nS^3 + 1\frac{1}{2}Aq$.
Sp. Gr. 3·20. H. = 2·75.

This mineral occurs in fine needles, forming tufts of crystals, which diverge slightly from one another. According to Shepard it offers a cleavage parallel to an oblique rhombic prism. Color greyish-white. Lustre silky. Opake or translucent only on the edges. Alone it does not melt B B; with soda it effervesces and fuses into a dark colored globule; and with borax forms a black glass, indicating the presence of much iron and manganese. It is found at Cummington and Plainfield, in Massachusetts, in mica slate associated with garnets. By most mineralogists it is united with epidote.

CHLOROPHÆITE.*

Dr. MacCulloch. (*Western Isles of Scotland*, i., p. 504.)

This mineral, when newly broken, is of a green color, varying from the fine transparent yellow-green of olivin, which it sometimes resembles, to the dull muddy green of steatite, to which it then bears an equal similitude. After a few hours' exposure it turns darker, and shortly becomes black. The fracture is generally conchoidal. It is so soft as to be scratched by a quill, and is brittle. Specific gravity 2·020. B B it remains unchanged, neither cracking nor sensibly altering its color nor translucency. Consists principally of silica and iron, with a little alumina, and probably an alkali.

It is found imbedded in the amygdaloid of Scuirmore in the Isle of Rum, the base being either a basalt or a black indurated clay-stone. It also occurs in Fifeshire, in Iceland, and in the United States, at Gill, Mass., and at Southbury, Conn.

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* Chlorophæite, from the Greek, in allusion to its appearing of a green color (when newly broken.)

The nodules are generally round, and vary from the size of a radish seed to that of a pea and upwards; sometimes they are hollow.

LEHUNTITE.*

Compact zeolite, *Thomson.* (*Outlines, &c.*, i., p. 338.)

Dr. Thomson has given this name to a species of zeolite which occurs at Glen Arm, a precipice on the east coast of the county of Antrim, in an amygdaloidal rock. Its constituents, by the analysis of Dr. R. D. Thomson, are:

Silica,	47·33
Alumina	24·00
Soda	13·20
Lime	1·52
Water	13·60
	99·65

If we allow for a small deficiency of silica, the constitution of Lehuntite is three atoms bisilicate of alumina, one atom bisilicate of soda and lime, and three atoms water. Formula: $3AlS^2+(\frac{8}{9}N+\frac{1}{9}Cal)S^2+3Aq$.

Sp. Gr. 1·953. H. = 3·75.

Color flesh-red. Appears to the naked eye like a lump of sugar. Under the microscope it appears to be composed of minute scales. The mass, when broken in two exhibits the appearance of five distinct layers, three of them flesh-red, and two of them white lines separating the flesh-red portion into three portions. Or it may be described as a flesh-red mass, with two parallel white lines near the centre. Translucent on the edges. B B fuses into a white enamel. With carbonate of soda it melts easily into a white enamel. With borax or biphosphate of soda it forms a transparent bead with a silica skeleton, which becomes opake on cooling.

EUDYALITE.†

Eudilyt, *Stromeyer.* Eudialyte. (*Jameson's Man.*, p. 322.) Carbunculus rhombohedrus, D.

Composed of silica, soda, zirconia, lime, the oxides of iron and manganese, muriatic acid, and water.

Silica'	52·47	53·32
Soda	13·92	13·82
Zirconia	10·89	11·10
Lime	10·14	9·79
Oxide of iron	6·85	6·75
Oxide of manganese	2·57	2·06
Muriatic acid	1·03	1·03
Water	1·80	1·80
	99·71 Stromeyer.	99·67 Stromeyer.

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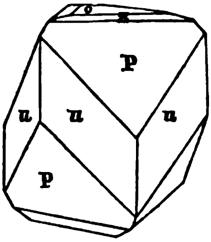
* In honor of Captain Lehunt.

† Eudalite, from the Greek, in allusion to its ready solubility in acids.

Taking the last analysis, Beudant gives this formula: $ZS^3+3(N, Cal, F)S^2$.

Sp. Gr. 2·89. H. = 5·0 — 5·5.

Eudyalite occurs both massive and crystallized, but the crystals are generally small and irregular. The following figure, however, is taken from a very perfect crystal nearly an inch in diameter, which was brought from Greenland by Gieśėckė. And the remarkably fine crystal in the possession of Mr. Brooke of London, having numerous secondary planes, has been measured by Levy,* who ascertained its primary form to be an Acute rhomboid of 73° 40′, and 106° 20′.



P on P over *u*	106°	20′
P on *z*	126	13
P on *u*	143	10
P on *o*	112	33

Its color is red or brownish-red, and generally somewhat translucent; lustre vitreous, cleavage parallel to *o* very perfect, less so parallel to *z*; fracture conchoidal or uneven. B B, it fuses into a leek-green scoria; and when reduced to powder loses its color, and gelatinizes with acids. This mineral was distinguished by Stromeyer; its locality is Kangerdluarsk in West Greenland, where it occurs either accompanying sodalite and hornblende, or imbedded in compact white felspar.

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* Edinburgh Journal, xii., 81.

CLASS III.

ACIDS.

Of the acids only three have been found in the uncombined state, viz., sulphuric, boracic, and arsenous acids.

NATIVE SULPHURIC ACID.

Liquid sulphuric acid, *Jameson*. Acide Sulphurique Hydraté, *Beudant*. Hydrous sulphuric acid. Aqua Sulphurica, D.

This acid has been found in its natural state in the caverns of the volcanic mountain Zaccolino, near Sienna. The concretions are in the form of cauliflowers, depending from the roofs of the grottoes, and adhering to sulphate of lime. Prof. Pictet mentions a cavern near Aix in Savoy, from the roof of which this acid, mixed with water and a little sulphate of lime, is observed to drop. It was also noticed by Dolomieu in the caverns of Etna.

In the United States a remarkable locality of this acid exists in the town of Byron, Gennesee county, N. Y. It is a spring from which the dilute acid flows in quantity sufficient to carry a light grist mill; the water at all times, being sufficiently acid to give the common test with violets, and to coagulate milk. It destroys and chars the vegetable matter with which it comes in contact.*

NATIVE BORACIC ACID.

Sassoline, J. Prismatic Boracic Acid, M. Acidum Boracicum, D.

The pure varieties consist of boron 33·68, and oxygen 66·32; or 1 atom boron+2 atoms oxygen. But they are usually mixed mechanically with several other substances. Klaproth found a specimen of sassolite to consist as follows.

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* See a particular description of this spring by the late Prof. Eaton, in the Amer. Jour. of Science, xv., 238.

	Sassolite.
Hydrous boracic acid	81·33
Sulphate of magnesia	10·50
" " lime	2·83
Silica	2·66
Carbonate of lime	1·66
Alumina	0·66
Peroxide of iron	0.33
	99·97

	Tuscany.
Boracic acid	76·50
Sulphate of ammonia	8·50
" " magnesia	2·63
" " lime	1·01
" " soda	0·91
" " potash	0·37
" " peroxide of iron	0·36
Alumina	0·32
Chloride of ammonium	0·29
Water	6·56
Sulphuric acid	1·32
Silica	1·02
	99·79 Wittstein.*

Sp. Gr. 1·48.

In loose scaly particles, or crystalline grains (probably six-sided tables), sometimes aggregated in the form of crusts. Color greyish or yellowish-white. The latter arising from admixture with sulphur. Lustre pearly; taste acidulous, and slightly bitter. It fuses readily at the flame of a candle, and yields a transparent glassy globule, which becomes opake on cooling if there be any gypsum in union. When dissolved in alcohol it communicates to the flame a fine green tint.

It occurs in a state of perfect purity, or mechanically mixed with a little sulphur, at the island of Volcano, one of the Lipari group; sometimes massive and in incrustations which present a fibrous structure; and frequently pulverulent, and disposed as a loose covering on the surface of the sulphur. It is likewise deposited by some of the lagoni of Tuscany, whence is brought the principal part of the boracic acid of commerce. It is collected in water, and then obtained in a solid state. During favorable seasons from seven to eight thousand pounds are thus obtained in one day.† The hot springs of Sasso afford the variety called Sassoline, which is sometimes in stalactites of a white color, and sometimes spotted with yellow. In the Andes of Acatana, South America, near the volcano Putana, boracic acid was found by Mr. Blake, both free and in combination with soda.

NATIVE ARSENOUS ACID.

Arsenious Acid. Acidum Arsenosum, D.

Composed, according to Berzelius, of arsenic 75·82, oxygen 24·18.

It has been found accompanying ores of silver, lead, and arsenic, at Andreasberg in the Hartz, also in Bohemia and Hungary. It occurs in minute capillary crystals, or stellae, implanted upon other ores; also in botryoidal and stalactitic masses.

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* London Chemical Gazette, Dec., 1842.

† Dr. Bowring on the statistics of Tuscany.

Sp. Gr. 3·69. H. = 1·5.

It has a vitreous or silky lustre, its color being white or with a reddish or yellow tinge. Transparent and opake. Taste astringent and sweetish. B B, it entirely escapes in white fumes. It is soluble in hot water. It is probable that its origin must be ascribed to the decomposition of some of the arsenical ores.

CLASS IV.

ACIDIFEROUS EARTHY MINERALS.

UNDER this head are comprehended those minerals which chiefly consist of an earth combined with an acid; some of them include variable proportions of oxides of iron, manganese, &c., which may be considered only as incidental ingredients.

SUBSULPHATE OF ALUMINA.

Aluminite, J. Websterite, *Levy*. Alumine Sous-sulfatée. Hallite. Trisulphate of Alumina, *Thomson*.

Combination of sulphuric acid, alumina, and water.

	Halle.	New Haven.	Auteuil.
Sulphuric acid	23·36	23·27	23·0
Water	46·33	46·76	47·0
Alumina	30·26	29·87	30·0
	99·95 Stromeyer.	99·90	100·0 Dumas

Its constitution is one atom sulphuric acid, three atoms alumina, and nine atoms water.

Sp. Gr. 1·669. H. = 2·0.

In reniform masses and botryoidal concretions, of a white or yellowish-white color, occasionally translucent, but more frequently dull and opake, with an earthy fracture; it yields to the nail, is meagre to the touch, and adheres to the tongue. It fuses with difficulty B B, but dissolves readily in acids, without effervescence. It imbibes water, but does not in consequence fall to pieces.

It occurs imbedded in ferruginous clay, which rests on the chalk strata on the coast near New Haven in Sussex; also at Epernay in France, and in plastic clay at Halle on the Saale in Prussia.

SULPHATE OF ALUMINA.

Sulphate of Alumina, *Boussingault.* Alunogene, *Beudant.*

Contains	Sulphuric acid	36·4	35·87
	Alumina	16·0	14·64
	Water	46·6	46·37
	Peroxide of iron	0·4	0·50
	Soda	0·0	2·26
		99·94 Boussin.	99·64 Thomson.

The mineral consists of one atom sulphate of alumina, and six atoms of water. Formula: $Al\dot{S}l+6Aq$.

Sp. Gr. 1·66. Very soft.

In crystalline masses and efflorescences. Color white, occasionally tinged yellow when impure; translucent; lustre silky; taste, and comportment B B, similar to alum.

Humboldt observed this mineral in clay-slate at Araya near Cumana; also at Socono, and elsewhere in South America. It is found in large quantities in Bolivia, and between Huasco and Coquimbo in Chili. Near Calama in Bolivia, it forms a bed from two to four feet deep. — *Blake.*

WAVELLITE.*

Wavellite, J. Alumine Hydro-phosphatée, H. Lasionite, Devonite, *Fuchs.* Wavellit, *Klaproth.* Hydrargillite, *Davy.* Hydrous diphosphate of alumina, *Thomson.* Astralus rhombicus, D.

Combination of phosphoric acid, water, and alumina, with a little lime, the oxides of manganese and iron, and fluoric acid.

	Devonshire.	Amberg.	Ireland.	Freiberg.	
Phosphoric acid	33·40	34·72	34·65	34·06	33·28
Alumina	35·35	36·56	34·00	36·60	36·39
Water	26·80	28·00	28·75	27·40	27·09
Lime	0·50	0·00	0·99	0·00	0·00
Oxide of iron & mang.	1·25	0·00	2·15	Ox. of iron 1·00	2·69
Fluoric acid	2·06	0·00	0·00	0·00	0·00
	99·36 Berz.	99·38 Fuchs.	99·55 Richardson.	99·06	99·45†

Formula as given by Dr. Thomson: $3Al^2\dot{P}h+5Aq$.

Sp. Gr. 2·337. H. = 3·5 — 4·0.

Primary a Right rhombic prism of 122° 15′, and 57° 45′.

It occurs in minute crystals, which usually adhere together and radiate, forming hemispherical or globular concretions from a very small size to that of an inch in diameter. The general form of the crystals is that of a rhombic prism with diedral terminations, but the lateral edges of the prism are sometimes replaced; and they are rarely sufficiently distinct to admit of measurement. It cleaves parallel to M and *h*, with brilliant surfaces; commonly translucent, sometimes opake, and possessing a silky or vitreous lustre; color yellowish-white, yellow, greyish, green, or bluish; occasionally of a dingy brown, owing to the progress of decomposition; brittle. It is infusible, but under the blowpipe becomes white, opake, and loses its crystalline form, giving a slight greenish tinge to the flame. It is soluble in heated acid, without effervescence, emitting a vapor which sometimes, (fluoric acid not always being present), slightly corrodes the glass.

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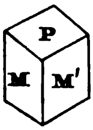
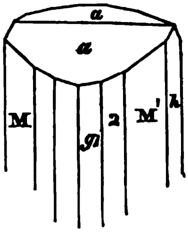
* Wavellite, in honor of Dr. Wavel, its discoverer.

† Analysis of two varieties from Freiberg, by Erdmann, as given in Rammelsberg's Handuœrterbuch des chemischen Theils der Mineralogie, ii., 265.

Primary.





M on M'	122°	15'*
a on *a*	107	26
a on *g*2.	122	24
*g*1 on *g*2	174	45 ?
*g*1 on *h*	112	30 ?
*g*2 on *h*	112	25

It was first discovered by Dr. Wavel in small veins and cavities in argillaceous schiste, near Barnstable, in Devonshire; it has been since found at Stenna Gwyn, near St. Austle in Cornwall, on a decomposing granite; in very highly colored pistachio-green masses at Clonmel, and near Cork; in white stellated groups on red sandstone at Zbirow and Benaun in Bohemia; on brown iron ore at Amberg, in Bavaria (a variety named by Fuchs *Lasionite*); in the Shaint Isles of Scotland; in Greenland in small globular masses on resinite quartz and anagonite, of a yellowish-grey and brownish-red color.—*Levy's Catalogue.* In South America, it has been found near Villa Ricca in Brazil, by Mawe, and in the mines of Hualgayoe by the celebrated Humboldt. The *Striegisan* of Breithaupt, from Striegis in Frankenberg, is evidently a variety of wavellite.

This is an exceedingly rare mineral in the United States. In the Reports of Prof. H. D. Rogers on the geology of Pennsylvania, it is mentioned as occurring in the slate quarries of York county; and Prof. F. Hall, cites a locality in the vicinity of Nashville, Tenn.; but specimens from these places are as yet rarely seen in American cabinets.

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* In giving the form of this mineral, Levy remarks that as the above measurements by Phillips do not agree perfectly with each other, and lead to very complicated crystallographical signs, they should only be regarded as approximations which require to be corrected by new observations. See his Catalogue, vol. i., p. 296. [Am. Ed.]

CACOXENITE.*

Kakoxene, *Steinmann*, (*in Brewster's Journal*, vol. 163.) Arealus radiatus, D.

Combination of phosphoric acid, water, fluoric acid, alumina, peroxide of iron, silica, and a small quantity of lime.

Phosphoric acid 17·86, alumina 10·01, silica 8·90, peroxide of iron 36·82, lime 0·15, water and fluoric acid 25·95.—*Steinmann.* Beudant remarks that it is difficult to arrange these constituents so as to deduce a formula for this mineral; but throwing out the lime and fluoric acid, he gives it thus: $\mathrm{AlS}+2\dot{\mathrm{F}}\mathrm{Ph}+5\mathrm{Aq}$.

Sp. Gr. 3·38.

In extremely minute fibrous crystals, which appear to be irregular six-sided prisms terminated by pyramids of six faces, generally disposed in diverging groups radiating from a point. Color brownish-yellow of different hues; lustre silky, sometimes adamantine; adheres to the tongue; has an argillaceous odor, and—probably from an accidental admixture with some saline substance—has an astringent taste. In water it partly loses its lustre and becomes brown; and when placed on a red coal it emits a green phosphoric light. B B, on charcoal, it decrepitates powerfully; with borax is incompletely soluble into a dark bottle-green colored glass; and with soda fuses with difficulty into a blackish mass.

Cacoxenite occurs disposed on brown iron ore in the iron mines of Hrbeck near Zbirow in Bohemia; and, but for its deeper tint, might be readily mistaken for karpholite, which is found under similar circumstances.

AMBLYGONITE.†

Amblygonite, *Leonhard.* Amblygonic Augite Spar, *Haidinger.* Augitus Lithicus, D.

Combination of phosphoric acid, alumina, and lithia.

Phosphoric acid 54·12, alumina 38·96, lithia 6·92.—*Berzelius.*

This mineral occurs massive, and in Rhombic prisms of 106° 10′ and 73° 50′, which are rough externally, and present a greenish-white, a mountain- or sea-green color. It cleaves parallel to the sides of the prism with brilliant surfaces; and when reduced to thin laminæ, it varies from translucent to transparent. On charcoal it fuses readily into a clear glass, which becomes opake on cooling; with borax it melts into a transparent colorless glass.

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* From κακος, bad, and ξενος, a guest, in allusion to the bad influence of its phosphoric acid on the iron extracted from the ore with which it occurs.

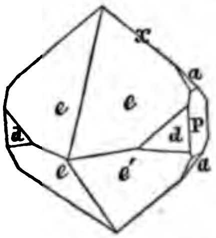
† From the Greek, in allusion to the obtuse angles of its prism.

It is found, with tourmaline and topaz, in granite, at Chursdorf near Penig in Saxony; and at Arendal in Norway. It was first recognized as a peculiar species by Breithaupt.

CHILDRENITE.

Brooke. (*Brande's Quarterly Journal*, vol. xvi., p. 274.) Fluellus Childrenii, D.

A compound of phosphoric acid, alumina and iron, according to Wollaston. Its complete analysis has not been given. H. = 4·5 — 5·0.



e on *e*	130°	20'
e on *e* over the edge *x*	102	30
e on *e'*	97	50
a on *a*	124	54

In very minute yellow or brownish-yellow crystals, disposed either singly or in crystalline coats on carbonate of iron or quartz. Cleavage in planes parallel to the axis; lustre vitreous, inclining to resinous; translucent; streak white; fracture uneven. The only known locality of this mineral is the vicinity of Tavistock in Devonshire; it was distinguished by Levy, who named it in compliment to Mr. Children of the British Museum. — *Allan's Manual.*

CALAITE.

Calaite, *Fischer.* Odontalite. Turquoise. Uncleavable Azure Spar, M. Callais, probably, of *Pliny.* Lazulus amorphus, D.

Consists, according to Berzelius, of phosphate of alumina and phosphate of lime, silica, the oxides of iron and copper, and a little water; while John noticed only

Alumina..................	44·50
Phosphoric acid	30·90
Oxide of copper	3·75
Oxide of iron.............	1·80
Water.....................	19·00
	99·95

Adopting this analysis, and rejecting the small quantity of oxides of iron and copper, its composition as stated by Dr. Thomson, is one atom phosphoric acid, three atoms silica, and two and a half atoms water. Or it is a hydrous triphosphate of alumina.

Sp. Gr. 2·8 — 3·0. H. = 5·0 — 6·0.

It occurs in reniform masses, which are either botryoidal or mammillated; has a peculiar greenish-blue color, but of various shades, passing on the one hand into sky-blue, and on the other into apple-green; and is dull internally; but occasionally the lustre is waxy, rarely splendent; fracture conchoidal; rough and uneven, frequently scaly. It is commonly opake; rarely translucent on the edges; streak white. The decomposed specimens resemble porcelain-clay. In the reducing flame of the blowpipe it becomes brown, and colors it green, but does not fuse; with borax it melts readily into a limpid glass.

The *oriental calaite* occurs in alluvial clay in the neighborhood of Nishapuri and Firuzkuh in the Persian Korassan; and is found on sale in most of the cities of Persia, being valued for ornamental purposes, and when highly colored, very much esteemed as a gem. The Persian king, retains for himself all of the most richly colored varieties.

Malachite, with which turquoise may sometimes be confounded, yields a green streak, while that of calaite is white.

The *occidental turquoise* found near the town of Simor, in Lower Languedoc, is merely tooth or bone, colored with phosphate of iron. Analysis by La Grange: phosphate of lime 80, carbonate of lime 8, phosphate of iron 2, phosphate of magnesia 2, alumina 1·5, water 1·6.

FLUELLITE.

Levy. *Wollaston.* (*Ann. of Phil.* 1824, p. 241.) Fluate of Alumina. Fluellus pyramialis, D.

Combination of alumina and fluoric acid.

In small acute rhombic octahedrons, whose angles are 109° 82′, and 144°; the acute solid angles generally replaced. White and transparent; lustre vitreous. Occurs with Wavellite and chalkolite on quartz at Stenna-gwin in Cornwall, but is an extremely rare mineral.

It was discovered by Levy, but examined and named by Dr. Wollaston, who could discover nothing in it but fluoric acid and alumina.

AZURITE.

Lazulit, W. H. Azurite, J. Prismatic Azure Spar, M. Klaprothine, *Beudant.* Feldspath blue, H. Blue Spar. Lazulus rhombicus, D.

This mineral is a hydrous diphosphate of alumina and magnesia.

	Blue Spar. Krieglach.	Radel-graben.
Phosphoric acid	43·32	41·81
Alumina	34·50	35·73
Magnesia	13·56	9·34
Lime	0·48	0·00
Oxide of iron	0·80	2·64
Silica	6·50	2·10
Water	0·50	6·06
	99·66 Brandes.*	97·68 Fuchs.

Taking the analysis by Fuchs, the atoms of acid, including the silica, amount to half the atoms of the bases, showing the mineral to consist of disalts. The oxide of iron and alumina which are united with the silica, as disilicates, Dr. Thomson supposes to be accidental, whence he gives the formula—

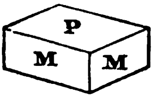
$$4Al^2\dot{P}h+Mg^2\dot{P}h+1\tfrac{1}{2}Aq.$$

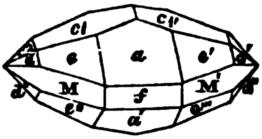
Sp. Gr. 3·0—3·1. H.=5·0—6·0.

Primary form a Right rhombic prism of 121° 30′, according to Brooke.

Lazulite rarely occurs crystallized, being more often granular, or in small fragments, exhibiting various shades of azure blue. It is slightly translucent, brittle, yet nearly as hard as quartz; the fracture is lamellar, and its cleavage is parallel with the planes of the prism, though indistinct. B B, it intumesces a little, and assumes a glassy appearance where the heat has been highest, but does not melt. With borax it yields a clear colorless globule.

Primary.





The second of the above figures represents a superb crystal in the possession of H. J. Brooke, Esq.

M on M′	121°	30′	*a* on *e* or *e′* or *a′* on *e″* or *e‴*	158°	10′
—— *e* or M′ on *e′*	138	45	*c*l on *c*l′	120	40
M on *d*	140	30	*c*l on *c*2′ or *c*l′ on *c*2′	150	00
M or M′ on *f*	150	45	*e* on *d* or *e′* on *d′*	162	36
a on *a′*	91	30	*c*l on *e* or *c*l′ on *e′*	139	25
—— *c*l or *c*l′	129	10	*c*l on *d*	141	20

It occurs in a gangue of quartz, near Vorau in Styria; and in narrow veins traversing clay-slate in the torrent beds of Schlamming and Radel-graben near Werfen in Saltzburg.

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* This mineral, analyzed by Brandes, has by some been separated into another species called blue spar, but there does not seem sufficient ground for the distinction. [Am. Ed.]

RHOMBOHEDRAL CARBONATE OF LIME.

CALCAREOUS SPAR.

Kalkspath, W. Chaux carbonatée, H. Spath calcaire, Br. Calc Spar, J. Calcius rhombohedrus, D. Calcite, *Brooke*.

Carbonate of lime, as a pure anhydrous salt, exists in two incompatible crystalline forms, viz., the rhombohedral as calcareous spar, and in the right rhombic prism as arragonite; the latter being isomorphous with carbonate of strontian, from which, however it is readily distinguished. It consists of one atom (2·75) carbonic acid, and one atom (3·5) lime = 6·25; or in 100 parts, of lime 56, carbonic acid 44. Formula: Cal$\dot{C}$. These numbers are nearly approached by the following analyses.

Lime.	56·15	55·50	56·33
Carbonic acid	43·70	44·00	43·50
	99·85 Stromeyer.	99·50 R. Phillips.	99·83 Biot.

Sp. Gr. 2·719. H. = 3·0.

Its most prevalent color is white; it is frequently transparent, and is then strongly doubly refractive. Occurs crystallized in upwards of eight hundred varieties of form, all originating from an Obtuse rhomboid of 105° 5′, and 74° 55′; this rhomboid may readily be obtained by cleavage, and may itself occasionally be cleaved parallel to a plain passing through the greater diagonals in one direction; the brilliant surfaces of the primary are well adapted to the use of the reflective goniometer. Cross fracture occasionally conchoidal, but not easily obtained. It effervesces violently with acids. The Iceland variety, which is considered to be the purest form of carbonate of lime, is transparent, and doubly refractive in a high degree, hence its familiar appellation *Iceland spar*, or *doubly refracting spar*. Some varieties of calcareous spar give a yellow phosphorescent light when laid on a hot coal or struck in the dark; as that accompanying garnet in Wermeland; laumonite in Britanny, &c. Alone, on charcoal, B B, it becomes caustic by heat, and shines with peculiar brightness as soon as all the carbonic acid is expelled. Does not yield water in the matrass, but with the fluxes comports itself like arragonite.

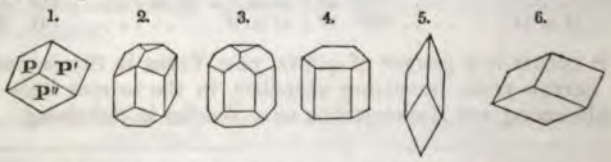
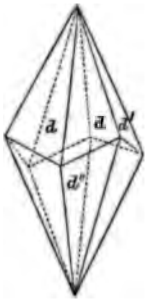


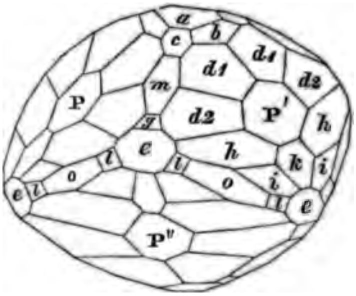
Fig. 1, the primary, an obtuse rhomboid. Fig. 2, the same, of which the lateral edges and terminal solid angles are replaced by planes. Fig.

3, in this both the lateral and terminal and solid angles are replaced. Both this and the former figure tend, by the extension of the modifying planes, to the production of the six-sided prism (fig. 4), on which no portion of the primary planes is visible. Fig. 5, an acute rhomboid. Fig. 6, a rhomboid more obtuse than the primary.

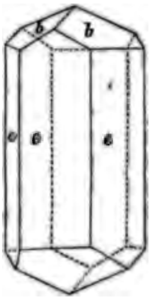
1.



2.

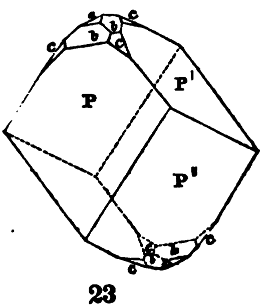


3.

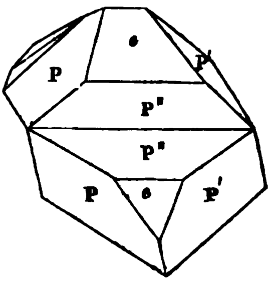


Bournon described fifty-six modifications of the rhomboid of carbonate of lime, and other mineralogists have greatly increased the number. It would be perhaps impossible to represent the whole of these with any tolerable accuracy on one figure; the above figure (2) therefore is intended only to point out the fact, that the several modifications are referrable to three great classes, viz., prisms, acute rhomboids, and obtuse rhomboids. Thus the planes *a* and *e e e*, replacing the solid angles, tend, by their extension, to produce a six-sided prism represented by the small fig. 4; the plane *a* with the planes *o o o* replacing the lateral edges, likewise tend to produce a regular six-sided prism, while *a* in conjunction with the planes *l l l l l l*, tend to a twelve-sided prism. Thus also of rhomboids, the plane *b* situated on the primary plane, and *c* on the edge, tend to two rhomboids much more obtuse than the primary, or than that which would be consequent on the extension of the planes *m*, while *g* and *k* would produce very acute rhomboids. The planes *d*1 *d*1, of which six are visible on the figure, would produce very obtuse dodecahedrons; the planes *d*2 *d*2, less obtuse; while the consequence of the extension of the planes *h h* would be acute dodecahedrons, and of the planes *i i* still more acute. But of rhomboids, both acute and obtuse, there is an almost endless variety, all actually differing by admeasurement.

Nova Scotia.



Rossie, N. Y.



It occurs in veins in almost every kind of rock, from the oldest to the newest alluvial strata, and accompanies or constitutes the gangue of a great variety of minerals. It is so generally distributed, that any enumeration of its localities would be impossible. Among those most distinguished may be mentioned Andreasberg in the Hartz, where the six-sided prisms have been found in great beauty; Alston Moor in Cumberland, which affords the flat rhombic crystals; and Derbyshire, whence the pale-yellow transparent pyramids, sometimes of very large dimensions, are obtained. The transparent variety from Iceland is not found in distinct crystals, although the surfaces of the masses indicate crystallization, and are often implanted with stilbite and heulandite. The crystallized sandstone of Fontainebleau, in France, (*chaux carbonatée quartzifère*, of Haüy,) is a variety of this species mechanically mixed with sand.

In Upper Canada, at Perth, Dr. Holmes has discovered a very beautiful pale rose-colored Iceland spar, from which doubly refracting cleavage rhomboids of several inches have been obtained. Near Montreal, Lower Canada, low lenticular crystals, a modification of the *équiaxe* of Haüy, abound in the dark colored limestone. In Nova Scotia this mineral is of very frequent occurrence in the trap rocks, appearing sometimes in the form of scalene triangular planed dodecahedrons, but usually in very acute rhomboids, and rarely in those more obtuse than the primary. They here accompany the various zeolite minerals, but are more generally found scattered over, or interspersed with, crystals of stilbite and Laumonite, which occupy the geodes and cavities of the amygdaloid. They are deeply striated parallel to the natural joints of the primary crystal, and are frequently in hemitropes. Though usually colorless and transparent, they are in some instances of a straw-yellow, or even honey-yellow appearance. A very common modification of the insulated rhomboids of this mineral from Nova Scotia, is that shown by the fourth figure on the last page, in which the terminal solid angles are replaced by tangent planes, *a*, and by three small planes, *b*, resting on the primary faces of the crystal. These tend to the production of a more obtuse rhomboid than the primary. There is sometimes an additional replacement *c*, resting on the edges of the crystal, but none of these replacements are carried to an extent which much obscures the ordinary rhomboidal form of the crystal.

We shall mention a few only of the numerous localities of this mineral in the United States. The finest crystals for size and transparency have been found at Oxbow, and at the lead mines of Rossie, St. Lawrence county, N. Y., in primitive limestone. They appear in the form both of rhomboids and scalene dodecahedrons, and are grouped with crystals of galena and pyrites in the most beautiful manner. Compound or twin crystals are very common at this locality, and the last figure on page 265, represents one of them in the editor's collection more than a foot in length. Cleavage rhomboids, perfectly colorless and transparent, may be obtained from these masses, measuring from four to six inches across their planes. Perfect hexahedral prisms (*prismatique* of Haüy, fig. 4, p. 264) occur in the narrow veins of the limestone, and are sometimes attached to a pink colored variety of this mineral. Crystals in the same form, but terminating in trihedral pyramids, the terminal solid angles of the rhomboid being replaced by planes resting on its primary faces, (*dodécahèdre* of Haüy, fig. 3, p. 265) have also been discovered at Martensburg, Lewis county, N. Y. In the newer limestone at Lockport, Lewiston and Niagara Falls, the dog tooth spar variety (scalene triangular planed dodecahedrons, *métastatique* of Haüy, fig. 1, p. 265) abounds, and is associated with magnesian carbonate of lime, and transparent selenite; more rarely with sulphate of strontian, fluor spar, and anhydrite. At Schroon, Essex county, N. Y., masses possessing a fine green tinge, have been found by Prof. Beck. Beautiful crystallizations of this mineral accompany the datholite and apophyllite at Bergen, N. J., the green fluor spar, at Lowville, Lewis county, N. Y., the Prehnite of Charlestown, Mass., the pearl spar and quartz near Phœnixville, Chester county, Penn.

The following are several varieties of this species, some of which assume the character of rocks.

1. SCHIEFER SPAR.* Schiefer-spath, W. Chaux carbonatée nacrée, H. Slate-spar, J. Argentine, *Kirwan*. This variety occurs massive, and in extremely thin tabular plates intersecting each other in various directions, but without any determinate crystalline form. Its color is usually white, with a shining and more or less pearly lustre; it is translucent, yields easily to the knife, and often possesses a greasy feel. Specific gravity about 2.5. It is infusible; but is soluble with effervescence in acids. It is an almost pure carbonate of lime.

It occurs in metalliferous beds in Norway; in Glen Tilt, Perthshire; in Assynt, Sutherlandshire; and in the county of Wicklow, in Ireland. In the United States extensive masses of it exist in the mica slate at Northampton, and smaller quantities have been obtained at Monroe, Conn

2. AGARIC MINERAL.† ROCK MILK. Berg milch, W. Chaux carbonatée spongieuse, H. Is of a white color, or yellowish or greyish white; and is soft, dull, meagre to the touch, soils the fingers, is very tender, opake, and so light as to float for a short time on water. It is nearly pure carbonate of lime.

It is found in beds and crevices of calcareous rocks in Switzerland, where it is employed for white-washing the houses; also near Ratisbon; at Sunderland in Durham; and in Oxfordshire.

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* Schiefer or slate-spar, in allusion to its slaty structure.

† Described by Pliny under the name of Agaricon; — resembling fungus.

3. **Aphrite.**[*] **Earth-Foam.** Schaumerde, W. Chaux carbonatée nacrée lamellaire, H. Ecume de Terre, Br. This variety is found sometimes solid, more often in a friable state; it consists of white scales of a shining pearly or pseudo-metallic lustre. It is opake, very soft to the touch, and nearly pure carbonate of lime. It is usually found in calcareous rocks in veins or cavities; and differs from schiefer-spar principally in being less coherent. It occurs in Hessia, and abundantly at Eisleben in Thuringia, in mountains consisting of stratified limestone.

4. **Stalactitic Carbonate of Lime.** Kalk-sinter, W. Chaux cabonatée concretionnée, H. Calc sinter, J. Occurs mammillated, or in long straight pendulous masses or tubes, coating the interior of caves and fissures. The fracture is either lamellar or fibrous, the fibres diverging from the centre; the cleavage always that of the perfect rhomb; with a pearly or silky lustre; prevalent color yellowish-white.

Stalactites are sometimes of prodigious dimensions, of which the grotto of Antiparos in the Archipelago, the extensive caves of Adelsberg in Carniola, and that of Auxelle in France, are striking instances. The most remarkable in Britain are to be found in the cavern of Castleton, and other caves in Derbyshire, and Macallister Cave in the Isle of Skye. They abound also in the celebrated caves in Virginia, as well as in the cavernous limestone elsewhere in the United States.

Stalactites are now continually forming. They are deposited from water loaded with particles of carbonated lime, in the hollows and caverns of mountains; the water, finding its way into these through crevices in the roof, becomes exposed to the air, evaporation ensues, and thus the calcareous particles are caused to precipitate. Some caverns have been entirely filled with calcareous stalactite, so that it is occasionally obtained in large masses; in this state it is called *Alabaster*, and is used in statuary and in the formation of vases; its name being derived from Alabastron, an Egyptian village between the Nile and the Red Sea, which was the principal locality known in ancient times.

5. **Granular Limestone.** Kalkstein, W. Chaux carbonatée saccharoïde, H. Granular limestone is massive, and consists of small grains or minute crystals, presenting a lamellar structure and brilliant lustre; but as these grains intersect each other in every direction, the lustre of the mass is only glimmering. It is of various colors; white, grey, yellow, bluish, reddish, greenish, &c., and is sometimes veined or spotted; fracture splintery, occasionally slaty, in consequence of containing parallel layers of mica; somewhat translucent, and brittle.

Granular limestone is found in many, if not in most primitive countries; it sometimes forms entire mountains, but more often occurs in beds. It is considered to be of contemporaneous formation with gneiss, porphyry, argillaceous and micaceous schiste, with which it frequently alternates. In the Alps and the Pyrenees examples of this are of frequent occurrence.

The whitest and more esteemed primitive limestone was termed by the French mineralogists, Chaux carbonatée saccharoïde, from its likeness to sugar when in small masses. From its important uses in the arts, it is commonly called *Statuary marble*. The most celebrated statuary marbles of ancient times were found in the islands of Paros, Naxus, and Tenos, in the Archipelago. Parian marble is white, large grained, and considerably translucent. The Pentelicon, taken from quarries on a mountain called Pentelicus, near Athens, is traversed by greenish or greyish veins, which are commonly micaceous. The marble of Carrara has a finer grain and closer texture, and is that now usually employed by statuaries; the quarries of this marble are on the eastern coast of the Gulf of Genoa, and are worked on the face of a mountain to the height of about eight hundred feet.

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[*] Aphrite, from the Greek; — a foam-like substance.

The name *Lucullite*, as applied to black marble, arose from the quantity of that color which Lucullus imported into Rome, from an island in the Nile. That from Kilkenny in Ireland encloses shells of a whitish color, which, when the marble is cut and polished, present segments of circles; this is much used for chimney-pieces and ornaments.

The *Verd antique* consists of carbonate of lime imbedded in green serpentine; its geological situation is not known.

The *Lumachelli marble* exhibits beautiful iridescent colors, which are sometimes prismatic internally, but more commonly of various shades of red or orange, whence it has also obtained the name of *Fire marble*. It occurs at Bleyberg in Carinthia, in beds forming the roof of a lead mine. Its colors are attributed to the shells of a variety of nautilus.

The *Cotham*, *Ruin*, or *Landscape marble*, found near Bristol, exhibits, when cut and polished, the appearance of a landscape or ruins; it is of common occurrence in the Val d'Arno near Florence.

6. ANTHRACONITE, *Swinestone*, *Stinkstone*,* which emits a strong fetid odor when scraped, owing, it is believed, to the presence of sulphuretted hydrogen, is found columnar, granular, and compact, and of various shades of grey, brown and black. The harder and more compact varieties, which receive a good polish, are used in ornamental architecture.

In Dalmatia a variety of limestone occurs so bituminous that it may be cut like soap, and is employed in the construction of houses; when finished, the walls are set fire to; the bitumen burns out, and the stone becomes white; the roof is then put on, and the house afterwards completed.

7. OOLITE† is always found massive, and in beds. The globular particles are sometimes composed of concentric lamellæ, and usually adhere by means of a calcareous cement; it is soft when first quarried, but hardens by exposure to the air. Its color is whitish, yellowish-white, or ash-grey, depending, as is believed, on the quantity and quality of the argillaceous matter with which it is usually combined. It is an impure carbonate of lime, and will not burn into quicklime. The Portland and Bath stones are varieties of this, and in many parts of the south of England its properties are well known as a building material.

8. PISOLITE or *Pea-stone*,‡ differs considerably from oolite. It is generally white, brown, or reddish, and is composed of round or spheroidal masses, from the size of a pea to that of a hazle-nut, imbedded in a calcareous cement. These masses always consist of concentric lamellæ, in the midst of which is commonly found a grain of sand. It is opake, soft, and brittle. At Klagenfurt in Carinthia, and at Carlsbad in Bohemia, it occurs in great quantities, the mineral waters in the vicinity of the latter rising from beds of pisolite.

9. CHALK. Kreide, W. Craie, H. Is a massive opake carbonate of lime, of a white, greyish, or yellow color, having an earthy fracture and a low specific gravity. It varies much in hardness, but is generally soft to the touch, and adheres to the tongue. It composes a large portion of the newest secondary rocks in the south of England, and contains abundance of marine as well as terrestrial organic remains. Its uses are well

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* From the strongly fetid odor it gives out when rubbed.

† Oolite, or Roe-stone; so denominated from the resemblance between the little round masses of which it is composed, and the roe of a fish.

‡ Pisolite or Pea-stone, from the similarity of its spherical masses to the pea.

known, in furnishing lime for manure and cement, in polishing metals and glass, as a marking material, and in painting and white-washing.

10. Marl is a mixture of limestone and clay, possessing an earthy fracture, a greater or less degree of compactness, and a yellow or reddish-grey color. It falls to pieces on exposure to the air, and is then plastic in water; it is partially soluble in acids, with violent effervescence It occurs in considerable quantity in Thuringia, and is produced by the decomposition of shells in bogs and standing water.

11. Tufa, Kalk-Tuff, W., is the most impure, the most irregular, and the most porous of all the varieties of carbonate of lime, being an alluvial deposit from calcareous springs. Immense formations of this substance have taken place near Terni, Tivoli, and other places in Italy; also in some parts of Germany From its generally occurring in a soft state, and its possessing the property of hardening on exposure to air and moisture, tufa makes a useful building material in the construction of bridges and docks. It varies in respect to hardness, is opake, rough, light, cellular, and often incrusts other substances, as vegetable stems, leaves, &c.

PRISMATIC CARBONATE OF LIME.

ARRAGONITE.[*]

Arragon, W. Arragonite, H. Prismatic Limestone, J. Prismatic Lime Haloide, M. Calcius rhombicus, D.

Consists of carbonate of lime, united with accidental portions of carbonate of strontian and water.[†]

	Arragon.	Waltsch.	Bohemia.
Carbonate of lime	94·82	99·29	97·98
Carbonate of strontian	4·08	0·51	1·09
Water	0·98	0·15	0·26
	99·88 Stromeyer.	100·05 Stromeyer.	99·33 Stromeyer.

Sp. Gr. 2·6—3·0. H. = 3·5—4·0.

This mineral occurs massive, the texture being generally fibrous, with a silky lustre; in the form of small branches consisting of fibrous crystals which diverge from a centre,—a variety known under the denomination of *Flos ferri;* also in crystals which at first sight appear to be regular six-sided prisms, but on close inspection present a longitudinal crevice down each lateral face, and somewhat similar appearances converging in the centre of the terminal planes; these, in fact, are macles consisting of three simple crystals which cross each other at particular angles. It cleaves parallel to the lateral planes of a Right rhombic prism of 116° 5′, and 63° 55′,—the primary form. Most prevalent color white, though sometimes tinged yellow, green, and blue. The crystals are internally shining or vitreous; they are translucent—the small ones sometimes colorless and transparent; yield to the knife and are brittle, but scratch calcareous spar easily. They refract doubly in particular directions. Thin fragments of transparent crystals decrepitate in the flame of a candle; other varieties lose their translucency and become friable. With borax it dissolves and forms a transparent glass, which c tallizes on cooling; but in soda it is insoluble. It presen yellowish-red phosphorescent light upon hot iron; and is s-ble in the nitric and muriatic acids, during which pr carbonic acid is disengaged: paper dipped into a mixtu this solution and alcohol burns with a purple flame.

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[*] Arragonite, from its having been first found in the province of Arragon in Spain.

[†] The results of chemical analysis have shown that the crystalline form of arragonite is in no way attributable to the presence of carbonate of strontian, and that this mineral has the same composition with common calcareous spar, though from circumstances not well understood, one has taken the shape of a Rhomboid, and the other that of a Right rhombic prism. See "Dimorphism," p. lxxxiv. of the Introduction to this volume. Also a very valuable article, by Prof. G. Rose, on the artificial production of arragonite, in the Lon. and Edinb. Phil. Mag., third series, vol. xii., p. 465. [Am. Ed.]

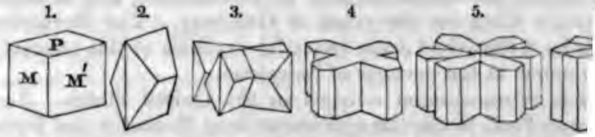
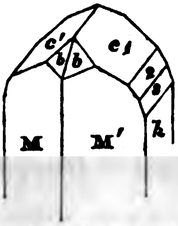


Fig. 1, the primary form, a Right rhombic prism, which in modified by planes replacing the four acute angles, so as to e plane P of fig. 1 to disappear. In fig. 3, two crystals of the as fig. 2 cross each other. Fig. 4 represents two crystals other, of which the planes M M and P of fig 1 appear, edges of that figure are replaced by planes parallel to the prism. In fig. 5, three similar crystals cross each other; these often occur so distinct, but usually as represented by fig. 6, in they are more closely united in the general form of a six-sided The dotted lines represent the cracks observable down each fa ing from the contact of the planes forming the diedral termina the several crystals of which fig. 5 is composed; and from the cause the six lateral planes of this apparently six-sided crystal are but each presents a slightly re-entering angle.



M on M'	116°	30'
M' on *h*	121	88
M on *c*1' or M' on *c*1 .	108	18
—— *b* or M' on *b* . .	144	00
*c*1 on *c*1'	108	18
—— *c*2	150	80
—— *c*3	141	00
—— *h*	125	55
—— *b*	136	30
—— *b* on *b*	129	33

This mineral is named from its locality, the province of Arragon, in Spain, where it was first found in large detached twin crystals, disseminated in a ferruginous clay, accompanied by sulphate of lime. The most transparent and best-defined prisms however, occur near Bilin in Bohemia, in a vein traversing basalt; while the branching or coralloidal varieties, to which the name of Flos-ferri has been given, occur in beds of iron ore, and are particularly beautiful in the Styrian mines of Eisenerz, where they appear stalactitically disposed on the roofs and sides of considerable cavities. The coralloidal arragonites of Arzberg, in Styria, are by far the most beautiful that have been found. Radiated and acicular minute white crystals have been found in the recent lavas of Vesuvius. The massive, silky, and fibrous variety, termed *satin spar*, occurs at Dufton, in thin veins, traversing shale, generally accompanied by iron pyrites; it is susceptible of a fine polish, and is employed in the manufacture of ornaments. Stalactitic specimens of a snowy whiteness have been met with at Leadhills; also in Buckinghamshire; in Devonshire; and in Dirk Hatterick's Cave on the coast of Galloway. The Bermuda Islands have furnished many beautiful varieties of this mineral, said to occur in the caverns of limestone.

This is an uncommon mineral in the United States. According to Prof. Beck, the specimens from Scoharie and from Rossie, N. Y., which have passed for arragonite, belong to the preceding species. But he gives one locality in the town of Monroe, N. Y., where it occurs in imperfect crystals, and in mammillary, botryoidal and fibrous forms. The variety *flos feri* occurs at Lockport, according to Shepard. The caverns in the limestone of Alabama, particularly at Franklin, have presented specimens of crystallized arragonite of surpassing splendor. The crystals are colorless and transparent, and in form like fig. 2, having their acute angles replaced, and frequently crossing each other, as shown in fig. 3. They are not however remarkable for size. They sometimes assume a flesh color.

Arragonite may with facility be distinguished from calcareous spar by exposing it to heat, before which it at once flies into powder, while the calcareous spar placed along side of it remains unchanged, and even retains its transparency. Its cleavage in a longitudinal direction should also be a sufficient characteristic — the faces of cleavage in calc spar, however small the individuals, being always inclined. — *Allan's Manual.*

DOLOMITE. BITTER SPAR.

Chaux Carbonatée Magnesifère Primitive, H. Bitterspath, W. Rhomb or Dolomite Spar, J. Macrotypous Lime Haloide, M. in part. Pearl Spar. Calcius Dolomæi, D.

This mineral, from its chemical composition, may very properly be designated as a calcareous carbonate of magnesia.

Dr. Thomson has analyzed several specimens of it both crystallized and granular, and finds its constitution to be one atom carbonate of lime (6·25), and one atom carbonate of magnesia (5·25). Formula: $Mg\dot{C}+CalC$.

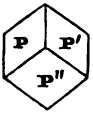
The following analyses by Berthier, Laugier and Suckow, lead to the same result.

	Namar.	Bourbonne.
Lime	29·1	29·2
Magnesia	21·0	21·2
Protoxide of iron	1·2	00·0
Carbonic acid and water	46·7	44·6
Foreign matter	2·0	5·0
	100·0 B.	100·0 B.

	Appenines.	Jena.
Carbonate of lime	55·2	55·36
Carbonate of magnesia	44·7	41·30
Oxide of iron	0·0	2·10
Silica	0·0	0·50
	99·9 L.	99·16 S.

Sp. Gr. 2·85 — 2·9. H. = 3·5 — 4·0.

Bitter spar is usually found in the form of its primary crystal, an Obtuse rhomboid, so nearly allied to that of carbonate of lime that it was considered the same until Wollaston discovered the difference by means of the reflective goniometer. Its angles are 106° 15′ and 73° 45′. Color greyish or yellow, with a somewhat pearly lustre; harder than calcareous spar, semi-transparent, and very brittle. It cleaves readily into rhomboids of the same form as the crystals. B B, bitter spar is not distinguishable from calcareous spar; it however is more slowly soluble in acids, and produces only a very slight effervescence.



P on P′	106° 15′
P or P′ on P″	78 45

The finest and most transparent crystals occur at Traversalla in Piedmont, at St. Gothard, and near Gap in France; it is also found in the Tyrol and Salzburg; and at Taberg in Sweden, with asbestus, talc, and chlorite.

In the United States it is abundant at Smithfield, R. I., in very large crystals associated with talc. It also occurs in talc at Roxbury, Vt., in yellowish and nearly transparent crystals. Crystals in the primary form occur in a massive variety at Ridgefield, Conn. In New York there are several localities of the varieties, as pearl spar at Little Falls and Herkimer, accompanying the quartz crystals; at Lockport and Niagara, forming many of the geodes in the limestone; in small curved crystals on Diamond Island on Lake George; and in imperfect and variously aggregated crystals, of a bluish white color, in Richmond county, near the Quarantine. At Hoboken, N. J., in the veins of compact carbonate of magnesia traversing serpentine, beautiful, nearly transparent crystals of dolomite have recently been discovered. The massive variety is abundant in Maine, Vermont, Massachusetts, New York, and Connecticut. The hydraulic limestones, occurring so extensively in New York, are of this character, and their indurating property, after calcination, is supposed to be owing principally to the presence of magnesia.

The following substances are considered varieties of bitter spar.

1. Miemite occurs crystallized, but more often massive. Internally it is splendent and pearly; its fracture is foliated and curved; color greenish-white or green; translucent; and brittle. Sp. Gr. 2·8. It is found imbedded in gypsum at Miemo* in Tuscany.

2. Pearl Spar.† Chaux carbonatée ferro-manganesifère, H. This is the most common variety of bitter spar. It occurs in obtuse rhombs, with curvilinear faces; generally presents a shining pearly lustre; is translucent, yields to the knife, but is harder than calcareous spar; color white, grey, or yellowish. Specific gravity about 2·5.

It occurs abundantly in the lead mines of the north of England; in those of Derbyshire; in that of Beeralston in Devonshire; in several mines in Cornwall; at Schemnitz in Hungary; at Kapnik in Transylvania; at Clausthal in the Hartz; at Freyberg in Saxony; and in many other places on the continent.

3. Massive Dolomite.‡ Magnesian limestone. It consists of fine crystalline grains, which are lamellar; is generally white, occasionally with a tinge of yellow or grey; is translucent on the edges, and, when struck, frequently emits a phosphorescent light, which is visible in the dark. It greatly resembles primitive limestone, but is readily distinguished by its feeble effervescence in acid.

It occurs in the Pyrenees, Saxony, France, Sweden, in Iona one of the Hebrides, and, though in a more impure state, in many counties of England — Somersetshire, Yorkshire, Nottinghamshire, &c. At Building Hill near Sunderland it forms globular earthy-like concretions; and in the same vicinity is found in slaty masses, which, when split into thin pieces, are very flexible, — a quality supposed to depend on the water it contains, as it is nearly lost when the mineral dries.

Gurhofian is of a snow-white color, and very compact; the fragments, which are sharp, are translucent on the edges; fracture flat conchoidal. In many respects it may be mistaken for semi-opal. It occurs in veins traversing serpentine between Gurhoff § and Aggsbach in Lower Austria.

The mortar obtained from this species is esteemed for cement, being less subject to decay, owing to its absorbing less carbonic acid from the atmosphere than that of common limestone. But for agricultural purposes it is of inferior value; for when laid on particular soils it tends rather to injure than to improve vegetation, which is wholly destroyed when the quantity is large; this effect is owing to the magnesia it contains. The cathedral of Milan, and the Minster and city walls of York, are built of magnesian limestone; the white marble of Paros, and that of Iona in the Hebrides, belong to this species; it therefore often admits, as well as limestone, of being cut and polished, and is described as being particularly durable.

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[*] Whence Miemite.

[†] From its pearly lustre.

[‡] Dolomite, in honor of the geologist Dolomieu.

[§] Whence Gurhofian.

ANKERITE.

Paratomous Lime Haloide, M. Wandstein of *Styrian Miners.* Calcius decolorans, D.

Analysis by Berthier: carbonate of lime 51·1, carbonate of magnesia 25·7, carb. of iron 20·0, carb. of manganese 3·0.

Formula: $8\mathrm{Cal}\dot{\mathrm{C}}+5\mathrm{Mg}\dot{\mathrm{C}}+3\underline{\mathrm{F}}\dot{\mathrm{C}}$.

Sp. Gr. 2·95—3·1. H. = 3·5—4·0.

Primary form a Rhomboid of 106° 12′. In crystalline masses of a white color, though sometimes tinged yellow and brown, from an admixture of iron. Cleavage perfect parallel to the faces of the rhomboid; lustre vitreous; slightly translucent; streak white; fracture uneven; and the surface generally striated. B B, *per se*, it becomes black, and acts on the magnet, but does not fuse; with borax it melts into a pearl. In nitric acid it is soluble with a brisk effervescence; and on exposure to the atmosphere its surface becomes darker. The species occurs at the Rathhausberg in the Gastein valley, Saltzburg; and in considerable quantity at the Styrian mines of Eisenerz, where it is prized both as an iron ore, and as a flux in the process of smelting. It was distinguished by Mohs, who named it in compliment to Prof. Anker of the Johannæum in Gratz.—*Allan's Manual.*

PLUMBO-CALCITE.

***Prof. J. F. W. Johnston.* (*Edinb. Jour. of Sci., new series*, vi. 79.)**

Consists of carbonate of lime 92·2, carbonate of lead 7·8.—*Johnstone.* These proportions are supposed to vary in different specimens. Sp. Gr. 2·829. H. = 3·2.

Form and cleavage the same as the primary rhomboid of calcareous spar; massive. When heated the carbonic acid is driven off, and the specimen assumes a reddish color. B B, it yields with soda a white enamel, but no reduced lead appears. But a small fragment dissolved in muriatic acid gives a white precipitate with caustic ammonia, becoming black by the addition of hydrosulphuret of ammonia, and gives, B B, a globule of metallic lead. It occcurs among the old workings at Wanlockhead in Dumfries-shire. In this mineral the salts of lead and lime mutually replace each other, without altering the form of the crystal, and are therefore said to be isomorphous with each other.

It has been lately shown that certain *arragonites* also con tain carbonated oxide of lead, instead of strontian, which is readily detected B B. In one specimen Böttger found 3·85 per cent., and Kersten only 2·19 per cent. in another. Carbonate of lead is thus shown to be *dimorphous*, occurring both as a rhomboid and as a right rhombic prism; as is the case also with carbonate of lime.

APATITE.[*]

Phosphate of Lime. Apatit, W. Rhombohedral Apatite, J. Rhombohedral Fluor Haloide, M. Asparagus Stone. Chaux Phosphatée, H. Moroxite. Phosphorite. Subsesquiphosphate of Lime, *Thomson.* Fluellus hexagonus, D.

Combination of phosphoric acid and lime, with fluoric acid and chlorine, or mixtures of them both.

	Snarum.	Cap de Gates.	Greiner.	*Asparagus Stone.*
Phosphoric acid. Fluoric acid....	42·90	44·27	44·35	44·33
Lime	54·75	55·30	55·57	55·67
Chlorine	2·10	0·43	0·07	0·00
Oxide of iron....	0·25	0·00	0·00	0·00
	100·00 G. Rose.	100·00 G. Rose.	99·99 G. Rose.	100.00 Seybert.[†]

These analyses give very nearly one atom (4·5) of phosphoric acid, to one and a half atom (5·25) of lime, showing the mineral to be a subsesquiphosphate of lime. There is an excess of lime, which is in combination with fluoric acid and chlorine, substances shown by Prof. G. Rose to be always present in this mineral as chloride and fluoride of calcium. By uniting these, the constitution of the mineral, as stated by Dr. Thomson, is one atom chloride and fluoride of calcium, six atoms subsesquiphosphate of lime. Formula: $6\mathrm{Cal}^{1\frac{1}{2}}\dot{\mathrm{P}}\mathrm{h}+\mathrm{CalChl},\dot{\mathrm{F}}\mathrm{l}$

Sp. Gr. 3·1 — 3·3. H. = 5·0.

Phosphate of lime is found massive *(Phosphorite);* and crystallized in six-sided prisms, terminated by one or more planes *(Apatite);* or the prism is terminated by a six-sided pyramid, and the lateral edges are sometimes replaced. It yields, though with some difficulty, to mechanical division parallel to all the planes of the Regular hexahedral prism, which therefore is considered the primary form; fracture more or less conchoidal, with a vitreous lustre; translucent, rarely transparent; white, yellowish-white, wine-yellow, green, blue or bluish-green, and red, — these colors sometimes intermixed in the same crystal. In a very high temperature, the edges and angles are rounded off, fusing difficultly = 4½ without addition; with borax it forms a clear globule, and in salt of phosphorus dissolves in great quantity, affording a transparent glass, which, when nearly saturated, becomes opake on cooling, and presents crystalline faces. Soluble without effervescence in nitric and muriatic acids; and when thrown in powder on live coal, emits a yellow phosphorescent light.*

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[*] Named by Werner, from *απαταω*, to deceive; in allusion to its being readily mistaken for certain other minerals.

[†] This specimen was from London Grove, Chester County, Penn. [Jour. Acad. Nat. Sciences, vol. ii. p. 139.]

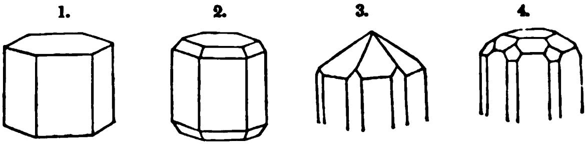
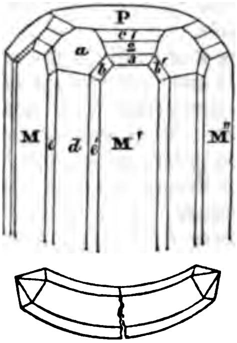


Fig. 1, the primary—a six-sided prism. Fig. 2, the same, of which the terminal edges are replaced; tending to a six-sided pyramid, which is perfect in fig. 3, the lateral edges of the prism being replaced. Fig. 4, in this the lateral and terminal edges of the prism are all replaced by planes, and its solid angles by small six-sided faces.



M on M′ or M′ on M″ . .	120°	0′
P on M M′ or M″.	90	0
M or M′ on *d*	150	0
M on *e* or M′ on *e*′	169	2
P on *c*1	157	0
—— *c*2	134	43
—— *c*3	120	38
—— *a*	124	16
M on *c*1	112	48
—— *c*2	130	30
—— *c*3	139	48
M′ on *b* or *b*′	149	40
b on *a*	162	18

It is somewhat remarkable that the planes *b b*′ are rarely seen together on the same crystal.

Ehrenfriedersdorf in Saxony, and Schlackenwald in Bohemia, are well-known continental localities of this mineral. The crystals from St. Gothard in Switzerland are remarkable for their whiteness and transparency, and the regularity of their complex forms; those from Arendal in Norway (*Moroxite*) are opake, and of a greenish-blue color; while the *asparagus-stone* or *spargelstein*, from the Zillerthal in the Tyrol, is translucent, of a wine-yellow hue, and imbedded in green talc. In the British Museum there is one very remarkable crystal, which is said to be from the vicinity of St. Petersburg, and beautiful crystals have been discovered at Caldbeck-fell in Cumberland; in Cornwall in tin veins in the granite of St. Michael's Mount, with topaz, &c.; with axinite on the cliffs of Botallack near the Land's End; and near Bovey Tracey in

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* The presence of fluoric acid in this mineral as evinced by its action on glass, may be shown by placing a powdered crystal in a platinum crucible, pouring upon it a small quantity of sulphuric acid, and proceeding as is usual in the experiment with fluor spar. [AM. ED.]

Devonshire, in large greyish-white translucent prisms, with crystallized tourmaline, in a quarry of red granite.

The massive variety of apatite is usually distinguished under the appellation of *phosphorite*. It presents a granular texture, and a yellowish or reddish-white color; is nearly opake; and becomes phosphorescent on the application of heat. It is found at Schlackenwald in Bohemia, and abundantly near Lagrofan in Estremadura in Spain, in beds alternating with limestone and quartz. In Nova Scotia, at Partridge Island, small but extremely brilliant crystals of a pale-yellow color were found by Dr. Jackson and the editor, in veins of foliated silicious sinter traversing the trap. Near Copiapo, in Chili, it is found massive and of a bluish-green color. Beads formed of it have also been discovered in some of the most ancient cemeteries in the same region. — *Blake.*

In the United States, apatite occurs abundantly in the white limestone of St. Lawrence, Jefferson, Lewis and Orange counties, N. Y., where the crystals are associated with felspar, scapolite, zircon, sphene and pargasite. They possess a great variety of colors, (as bluish-green, sea-green, mountain-green, yellowish-green, and sky-blue,) have highly lustrous planes, and those from Hammond, St. Lawrence county, where the smaller crystals are not inferior to those from any known locality, are most deserving of notice on account of their huge dimensions, many of them being from six to eight inches in length, while in a few instances they have been met with a foot or more in length. The more slender prismatic crystals are frequently bent in the middle, obviously whilst in a soft state, either when first formed, or by subsequent fusion (see the fig. p. 277). As the terminations are rounded, the sharp angles as it were melted away, and they assume otherwise a fused cavernous appearance, Prof. Emmons has, with good reason, adadduced them as additional evidence of the igneous origin of the primitive limestone in which they are imbedded. (See his *Report on the Geological Survey of the State.*) These crystals rarely present any other modifications than those of the replacement of the terminal edges of the prism, *pyramidée* of Haüy; but Prof. Beck has given the figure of a crystal from this locality in which the edges both of the prism and the *pyramid* are replaced by tangent planes. — *Mineralogy of New York*, page 241. Low compressed prisms, of which the terminal edges are replaced by a single row of molecules, *uniannulaire* of Haüy, have been found at St. Anthony's nose, near New York, accompanied by magnetic pyrites. They are sometimes so flattened, as to put on the appearance of an eight-sided table with bevelled edges.[*] The vicinity of Gouverneur, N. Y., has also furnished the same form — fig. 2 — M on *c* 129° 13′, P on *c* 140° 47′, *c* on *c* 143° 7′. — *Haüy*. In Lancaster, Billerica and Stowe, Mass., good crystals of apatite have been found; and at the former place, connected with spodumene. At Franklin, N. J., greenish-white hexahedral prisms are found with Jeffersonite. It also occurs near Baltimore, Md., and near Wilmington, Del. In Maine, at Brunswick, on the banks of the Androskoggin, disseminated in gneiss, with garnets. At Suckasunny, N. J., in small prisms, associated with actynolite, (byssolite), and more rarely with pearly heulaudite.

Appendix. *Fibrous Phosphate of Lime or Eupyrchroite*, of Prof. Emmons.[†] This is a very singular mineral and the first example of phosphate of lime occurring under a fibrous form. Indeed, it is supposed by Prof. Emmons to be a new species, but according to the analysis made by Prof. Beck, it contains ninety-three per cent. of phosphate of lime, the remainder being oxide of iron, alumina, silica and water, which are most probably mere accidental impurities. With this chemical composition, and in the absence of any well marked crystalline structure, it seems more proper to consider it as a variety of the present species. The following description of its characters has been drawn up by Prof. Emmons.

Color pale malachite-green, passing also into greenish-white, and sometimes brownish. Structure indistinctly fibrous in the thin mammillated layers, which are arranged like those of green malachite. Colors of the separate layers various. Dull and opake. Hardness = 4. Specific gravity 3·03.

It is fusible, B B, with difficulty, after a long continuance of the blast, and on the surface only, into a glassy glaze. Decrepitates; with borax and salt of phosphorus it fuses into a pale bottle-green glass when hot or warm, but transparent when cold. Heated to a point just below redness it phosphoresces with an emerald-green light. Heated in a glass tube it gives off a little vapor. In muriatic acid it dissolves easily and perfectly with a slight ebullition; from this solution oxalate of ammonia throws down a white precipitate; also the carbonates of ammonia and soda an abundant white flocculent precipitate. The muriatic solution evaporated to dryness is perfectly redissolved by acidulated water.

This remarkable mineral occurs a mile south of Hammondsville, at Crown Point, not far from the landing. It has a resemblance to malachite, somewhat in color and structure, but evidently contains no copper. It has, in fact, in its external or natural historical characters, as well as chemical, quite a striking resemblance to Wavellite and Gibbsite. It occurs abundantly in tuberose and mammillated masses in gneiss and limestone.

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[*] Dr. Troost, Jour. Acad. Nat. Sci., (Philadelphia), vol. ii. p. 56.

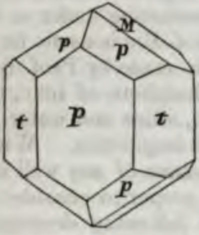
[†] See his Second Annual Report on the Geological Survey of New York, p. [illegible].

Its name, *eupyrchroite*, has an allusion to its beautiful phosphorescence when exposed to heat.

HERDERITE[*]

Prismatic Fluor Haloide, *Haidinger*. Fluellus rhombicus, D.

Primary form a Right rhombic prism of 115° 9′ and 64° 51′.
Sp. Gr. 2·9 — 3·1. H. = 5·0.



p on *p* over M	77°	29′
p on *p* contiguous . .	144	16
t on *t* contiguous . .	64	51

Cleavage interrupted parallel to M. Fracture small conchoidal. Color several shades of yellowish- and greenish-white; very translucent; with a vitreous or somewhat resinous lustre. Streak white; surface of M smooth, and delicately striated parallel to its edges of combination with *p*.

Herderite much resembles asparagus-stone, but was distinguished by Haidinger. — *Brewster's Journal*, ix. 360. It occurs imbedded in fluor, in the tin mines of Ehrenfriedersdorf in Saxony; and is a very rare species.

FLUOR SPAR.[†]

Fluorine, *Beudant*. Fluate of Lime. Fluss, W. Chaux fluatée, H. Octahedral Fluor, J. Octahedral Fluor Haloide, M. Fluellus octahedrus, D.

Combination of one atom fluoric acid, and one atom lime. Formula: $Cal\dot{F}l$.

	Derbyshire.	Gersdorf.	Cumberland.
Lime	72·68	67·75	72·14
Fluoric acid	27·32	32·25	27·86
	100·00 Davy.	100·00 Klaproth.	100·00 Berzelius.

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[*] In compliment to Baron von Herder, the director of the Saxon mines at Freyberg.

[†] From the Latin *fluo*, to flow — in allusion to its important use as a flux to the metallic ores.

Sp. Gr. 3·0 to 3·3. H. = 4·0.

Fluor occurs crystallized, nodular, compact, and earthy; the first has a perfectly lamellar structure, and may be cleaved with facility into the tetrahedron, acute rhomboid, and Regular octahedron, the latter of which has been adopted as its primary form; occasionally however the edges of a cube of fluor may be displaced mechanically, affording an apparent cleavage parallel to the planes of the rhombic dodecahedron; but this is only deceptive, for the planes so produced are irregular, and therefore unlike those parallel to the planes of the octahedron, and may be termed *planes of composition*. It occurs in the form of the octahedron and its varieties; as the cube, dodecahedron with rhombic planes, &c. Fluor is found perfectly limpid and transparent; also white, grey, and exhibiting various shades of blue, green, red, yellow, and purple: when pounded and placed on live coal it emits a phosphorescent light, blue, green, purple, or yellow; when thrown in mass into the fire, it decrepitates and flies. Is acted upon by acids, and particularly by heated sulphuric acid, which decomposes it, and disengages fluoric acid in vapors. Alone on charcoal it fuses by much heat into an opake white globule; with borax, and salt of phosphorus it forms a transparent glass, which when saturated to a certain extent becomes opake.

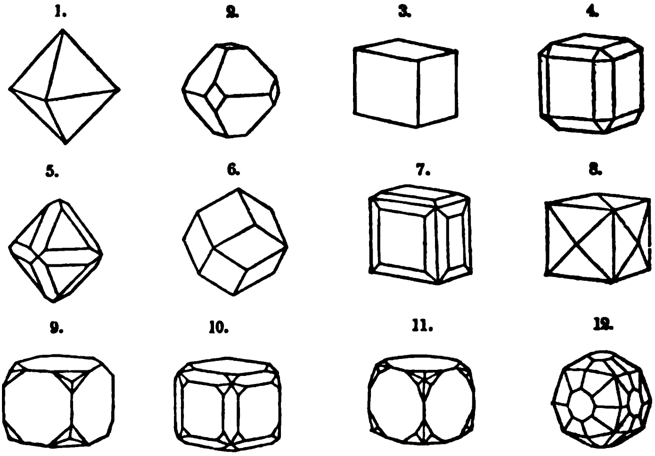
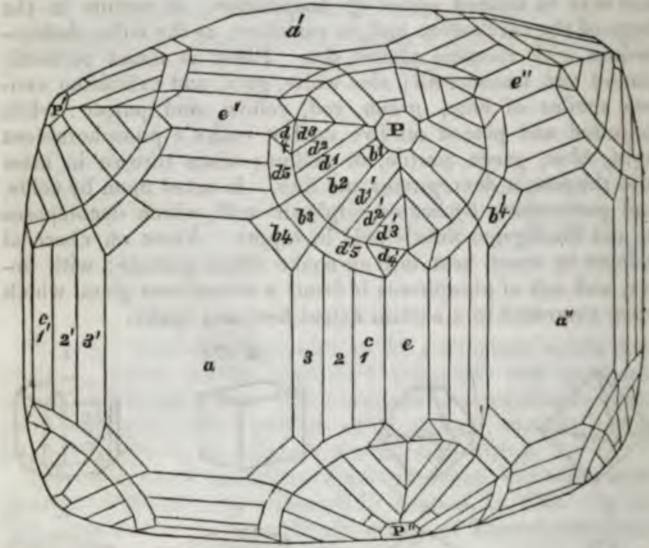


Fig. 1, primary; the regular octahedron. Fig. 2, the same, having all its solid angles replaced by square planes, which are enlarged and complete in fig. 3, the cube. Fig. 4, the cube, of which the edges and angles are replaced. Fig. 5, the octahedron, with its edges replaced by six-sided planes; which in fig. 6 are complete and of a rhombic shape, forming the rhombic dodecahedron. Fig. 7 the cube with its edges bevelled, or replaced by two planes; these planes are complete in fig. 8, forming a solid bounded by twenty-four triangular planes. Fig. 9, the cube, having each solid angle replaced by three planes, which in fig. 10 are seen in combination with planes replacing the edges of the cube. Fig. 11, the cube, of which each solid angle is replaced by six planes; these are enlarged and nearly complete in fig. 12; representing a crystal bounded by fifty-four planes.

One crystal (from Devonshire) in Mr. Phillips's possession exhibited all the faces represented on the annexed figure except *b*1 3 and 4, and *c*3.



P on P′, or P on P″ . .	109°	28′ H.	*b*4 on *b*4′	92°	50′
P on *a a*′ or *a*″	125	15 —	*c*1 on *a*	147	00
—— *e e*′ or *e*″	144	44 —	*c*2 on *a*	174	40
a on *a*′ or *a*″	90	00 —	*c*3 on *a*	179	40
e on *e*′ or *e*″	120	00 —	*d*1 on *d*1′	166	50
a or *a*′ on *e*′, *a* or *a*″ on *e*, or *a*′ on *a*″ on *e*″	135	00 —	*d*2 on *d*2′	160	12
			*d*1 or *d*1′ on *a*	153	10
*b*2 on *a*	154	45	*d*2 or *d*2 on *a* . . . . . . ·	155	44
*b*3 on *a*	156	50			

No part of the world has hitherto produced finer specimens of this species than the counties of Cumberland, Derby, and Cornwall. Those varieties from the lead mines of Alston Moor and Derbyshire, usually assume the form of the cube, and present the finest shades of blue and green, varying in color as the light by which they are examined is reflected or transmitted; some beautiful octahedral forms occur at Beeralston in Devonshire, while the neighboring county of Cornwall has afforded an endless variety of crystallizations. Dark-blue cubical crystals have been noticed in porphyritic greenstone near Gourock in Renfrewshire, also though sparingly in Aberdeenshire; but fluor is on the whole a rare production either of Scotland or Ireland.

Crystallized fluor is found at Mont Blanc and St. Gothard—on the latter in octahedrons of a rose-red color; in Saxony, the Bannat, and other countries, it occurs in veins in primitive mountains, exhibiting various modifications and great varieties of color; and at Zinnwald in Bohemia, accompanies oxide of tin, mica, apatite, and quartz.

In the United States a beautiful pale green fluor spar in octahedral crystals, occurs on the White mountains, N. H., in the ruins of a slide east of Saco, as described by Prof. Hubbard. It is imbedded in masses of radiated quartz, and the crystals are sometimes an inch and a fourth in diameter. At Eaton and Westmoreland, N. H., it occurs in considerable abundance, accompanying copper and iron pyrites; also at Putney, Vt., of an emerald-green color. The lead mine at Southampton, Mass., has also furnished a beautiful green and purple variety. At Trumbull, Conn., it is associated with topaz, mica and quartz, and is sometimes crystallized. Exposed to heat it has the character of *chlorophane.* Crystals of large dimensions, sometimes a foot in diameter, have been found on the southern bank of Muscolunge Lake, Jefferson county, N. Y. They are usually of a greenish color. At Lowville, Lewis county, both cubical and octahedral crystals are found in narrow veins in limestone with iron pyrites and galena; they are of a green color and nearly transparent. Very rarely, insulated crystals of this mineral of a yellow color are met with in the geodes of pearl-spar and celestine, at Lockport and Niagara, N. Y. According to Prof. Beck, crystals of a purple color, and exhibiting the form of the *cubo-octaédre* of Haüy, have been obtained at Rossie, as also large and very perfect dodecahedral crystals in the town of De Kalb, St. Lawrence county, N. Y. In New Jersey it is disseminated in the limestone at Franklin. Fine deep purple colored cubes have been brought from Smith county, Tenn.; and other varieties from Shenandona county, Vir., and from Shawne Town, Ill.

Near Castleton in Derbyshire, fluor is found in detached masses, whose structure is divergent, and their colors, as grey, yellow, blue, brown, are generally disposed in concentric bands; of this variety, called *blue john* by the miner, beautiful vases, obelisks, and other ornaments, are made.

Compact fluor is harder than common fluor, and has sometimes a granular texture; in general it is translucent only on the edges; when placed on live coal, it mostly gives out a green light, but some specimens exhibit various shades of green, blue, violet, and red. It occurs at Stolberg in the Hartz, where, when first raised, it presents a fine sky-blue color, but shortly, on exposure, becomes perfectly white; also in Norway, Sweden, and Cornwall.

Earthy fluor exhibits a friable texture. It is found in Saxony and Norway; in Durham, with partially decomposed galena; and in a granular pulverulent state, in the Beeralstone lead mine, Devonshire.

The name *Chlorophane* has been applied to these varieties which, when exposed to heat, exhibit the phenomenon of phosphorescence in peculiarly bright-green colors. One presenting an imperfectly lamellar structure, and of a pale-violet color, from Nertcschinsk in Siberia, possesses this property to a remarkable degree; and in some of the Cornish specimens it is also easily detected. It does not fly in the fire, but gives out a phosphorescent light of a most beautiful emerald-green,* which, if not exposed to too high a temperature, it will exhibit repeatedly.

The circumstance of its fluoric acid being disengaged when treated with sulphuric acid, renders fluor spar a useful medium for executing etchings on glass, which are readily obtained by exposing a plate partially coated with wax to the action of this acid as it is evolved in a gaseous state; that portion of the glass covered by the wax of course remains entire, while whatever has been laid bare will shortly be found to have been acted upon to a considerable depth, and thus figures of any description may be produced on glass without much difficulty.

ANHYDROUS SULPHATE OF LIME.

ANHYDRITE.

Muriacite, Wurfelspath, W. Chaux Sulphatée Anhydre, H. Anhydrite, J. Prismatic Gypsum Halojde, M. Gypsalus rectangulus, D.

When pure it consists of one atom (5) sulphuric acid and one atom (3·5) of lime. Formula: $Cal\dot{S}$.

	Sulz.	Eisleben.	Vulpino.	Bohemia.
Sulphuric acid	57·0	56·28	58·00	56·0
Lime	42·0	41·48	41·70	39·0
Water	0·0	0·75	0·07	0·0
Barytes	0·0	0·00	0·00	3·0
Silica	0·2	0·00	0·09	0·2
	99·2 Klaproth.	98 51 Rose.	99·87 Stromeyer.	97·2 Beudant.

Sp. Gr. 2·5 — 2·9. H. = 3·0 — 3·5.

Anhydrite occurs crystallized in the form of a Right rectangular prism, of which the lateral edges are sometimes, though rarely, replaced. It readily yields to cleavage parallel with the planes of the prism, but with more difficulty in one direction than in the other two. It is white, violet, bluish, or reddish; is translucent, sometimes transparent; with a splendent, pearly lustre. It possesses double refraction. In the matrass it yields no water, and it does not exfoliate like gypsum B B, but becomes glazed over with a white friable enamel; with borax it fuses with effervescence into a transparent glass, which on cooling is yellowish-brown, and which, it the proportion of the assay be considerable, becomes brown and opake; with fluor spar it forms a transparent globule while hot, which alters into an opake-white enamel when cold.

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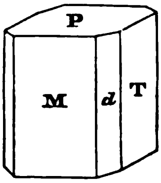
* Whence Chlorophane, signifying brilliant green.



P on M or T	90°	0′	H.
M on T	90	0	—
M on *d*	140	4	—
T on *d*	129	56	—

It is found in the salt mines of Hall in the Tyrol, and Bex in Switzerland; also in cleavable masses of a brick-red color imbedded with gypsum and polyhalite, in beds of rock salt at Aussee in Upper Austria. In the United States, at Lockport, Niagara county, N. Y., this mineral occurs in foliated nearly transparent masses of a sky-blue color, in the geodes of the limestone.

Compact Anhydrite or *Vulpinite* occurs massive, contorted, and reniform. It is found in the salt mines of Upper Austria and Salzsburg; at Sulz on the Neckar in Wirtemberg, and at Bleiberg in Carinthia. The contorted variety termed *pierre des trippes* (from its resemblance to the convolutions of the intestines) occurs in clay, in the salt mines of Wielitzka and Bochnia in Poland; while the variety which takes a fine polish, and is known by artists as the *marmo bardiglio di Bergamo,* occurs with limestone at Vulpino in Italy.

HYDROUS SULPHATE OF LIME.

GYPSUM.*

Sulphate of Lime. Selenite. Gyps, W. Chaux Sulphatée, H. Axifrangible Gypsum, J. Prismatoidal Gypsum Haloide, M. Gypsalus Rhomboideus, D.

This is a hydrous sulphate of lime, consisting of one atom sulphuric acid, one atom lime, and two atoms water. Formula, $\mathrm{Cal\dot{S}l+2Aq}$. Analysis by Bucholz: Sulphuric acid 46·0, lime 33·0, water 21·0.

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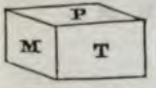
* Gypse is said to have been the term given by the ancients to calcined sulphate of lime; that mineral in its natural state is now termed gypsum; it contains water.

Sp. Gr. 3·26 to 2·4. H. = 1·5 — 2·0.

Of gypsum there are several varieties. It occurs crystallized; fibrous; having a granular texture; compact; and earthy.

Selenite[*] occurs generally in flattish crystals. The primary form is a Right oblique-angled prism, of which the bases are oblique-angled parallelograms of 113° 8′ and 66° 52′; it cleaves with ease and brilliancy, parallel only with the terminal planes P of the following figures, but cleavages parallel to the lateral planes may be attained from the finely divided laminæ; lustre shining, sometimes pearly; more or less transparent, and so soft as to yield to the nail.

1.



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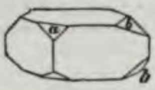

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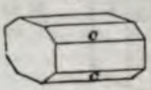

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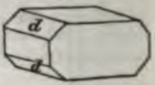
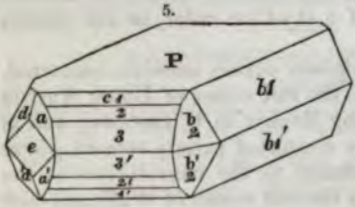


The preceding figures are given only with a view to elucidate the manner in which the modifying planes *a b c d* of the following figure are situated on the angles or edges of the primary.

5.



P on M or T (primary)	90°	00′
M on T . . . . ditto .	113	08
P on *b*1	108	00
—— b2	144	40
—— *c*1	153	55
—— *c*2	143	42
—— *c*3	124	20
—— *a*	112	14
—— *d*	110	51
—— *e*	90	00
*b*1 on *b*1′	143	48
b2 on b2′	108	05
*c*3 on *c*3′	111	20
a on *a*′	138	42
a on *c*3	118	18
d on *a*	149	20
*b*2 on *c*3	126	00*cg*.

It presents various shades of white, yellow, grey, brown, red, and violet. Reduced to thin laminæ, it is flexible but not elastic. Gives off water in the matrass; and, B B, in the platina forceps, exfoliates and fuses with difficulty into a white enamel. With fluor spar it readily fuses.

Selenite is most commonly met with disseminated in argillaceous deposits; not often in veins. The finest and most transparent crystals occur in the salt mines of Bex in Switzerland, at Hall in the Tyrol, in the sulphur mines of Sicily, near Oçana in Spain, and in detached and very symmetrical individuals in clay at Shotover Hill in Oxfordshire. Large lenticular crystals, and the scaly varieties, are found at Montmartre near Paris. Broad foliated masses are common in the gypsum of Nova Scotia, and recently fine large groups of crystals of a brown color have been found at Sussex Vale, in the Province of New Brunswick. A remarkable specimen of the latter is in the possession of Dr. Martin Gay of Boston.

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[*] Selenite, from the Greek; in allusion to the brilliancy with which it reflects the moon.

The tertiary formations of Virginia and Maryland, abound in large and very beautiful groups of crystallized selenite, particularly St. Mary and Calvert counties, which have been carefully explored by Messrs. T. A. Conrad and F. Markoe, Jr. Crystallized and massive gypsum occurs in New York; the former having the primary figure replaced on its longer terminal edges, is finely exhibited in some of the specimens from Lockport; the fibrous variety, possessing considerable lustre, is found in Onondaga county, and in most of the extensive plaster beds in the western part of the State. Remarkably beautiful transparent crystals having both the longer and shorter terminal edges replaced, (figs. 3 and 4) are imbedded in a snowy-white gypsum at Poland, Trumbull county, Ohio. The pure transparent folia from Lockport, contain small cavities enclosing a colorless fluid, which, from the sluggish movement to and fro of the small globule of air contained in it, resembles oil of vitriol. These specimens penetrated by dog tooth spar, and celestine, frequently possess great beauty, and form some of the most ornamental treàsures of our cabinets.

Compact Gypsum occurs only massive; its fracture is compact, or slightly splintery, it is dull, or possesses a glimmering lustre; is soft and translucent on the edges. Its colors are much the same as those of selenite, but it is often party-colored; either spotted or veined.

It occurs in England, at Ferrybridge in Yorkshire, in Nottinghamshire, and in Derbyshire. Near Sienna in Tuscany it is obtained extremely pure and compact; and is employed by the architect for columns and other ornaments, being more easily worked than marble; it also admits of being turned on the lathe into cups, basons, vases, and other similar articles. In South America in the Cordillera of Chili, the Valle del Yeso, takes its name from a great bed of pure white gypsum, which is at least two thousand feet thick, and where it is used in the manufacture of wine. —*Darwin's Journal of Researches*, p. 389. The most extensive deposits of gypsum in North America, are found in the new red sandstone formation of Nova Scotia, whence the greater part of all that is employed in agriculture in the United States, is obtained. Gypsum is sometimes found even among the scorias of volcanoes, as at the Sandwich Islands. In the United States extensive beds of compact gypsum occur in Ohio, Illinois, Virginia, Tennessee and Arkansas; frequently associated with salt springs.

Fibrous Gypsum occurs in extremely delicate and easily separated fibres; also massive, of which the fibres are either straight or curved. It has a glistening or pearly lustre, and presents various shades of white, grey, yellow, and red; it is generally translucent. It occurs in Derbyshire in long slender fibres, and particularly at Matlock, where it is found in masses of great brilliancy and remarkable lustre.

GRANULAR GYPSUM generally occurs massive, being composed of an aggregation of small crystalline laminæ. It has a shining pearly lustre; is translucent; and very soft. Its colors resemble those of selenite. It occurs in beds in primitive and secondary rocks. At Luneburg it is the matrix of the boracite. Large quarries of a pure white variety exist near Cavalese in the Southern Tyrol; also at Vizille, near Grenoble in France. In Cheshire and Derbyshire it forms beds in marl.

EARTHY GYPSUM occurs in loose earthy particles or scales, which are dull, or possess a glimmering lustre, in beds, enclosed within the strata of secondary formations of gypsum, in Saxony, Salzburg, and Norway.

The most decided characteristic of crystallized gypsum is the flexibility of its laminæ, into which it may be separated to almost any degree of thinness; the massive varieties are at once distinguished from limestone by their inferior hardness, being readily scratched by the nail, and yielding a white powder.

NITRATE OF LIME.

Kalk Salpeter, L. Chaux Nitratée, H. Nitrate de Chaux, *Beudant.* Nitrocalcite. Picralum tenellum, D.

Consists of nitric acid 57·44, lime 32, water 10·56; answering very nearly to the formula: $\text{Cal}\dot{\text{N}}\text{t}+\text{Aq}$.

Primary form a Rhomboid, or a regular six-sided prism.

It occurs in fibrous efflorescences often united in the form of silken tufts, or pulverulent; is very deliquescent, and soluble in water. On burning coals it melts slowly, with slight detonation, and, as it dries, loses its acid; the residue does not afterwards attract moisture from the air, and is phosphorescent; taste bitter and disagreeable.

It is found in silky efflorescences on old walls, in caverns, or on calcareous rocks, in the neighborhood of decayed vegetable matter; and in some mineral waters. It is said to form silky efflorescences in some of the limestone caverns of Kentucky; whence it is obtained for the making of saltpetre.

DATHOLITE.[*]

Borosilicate of Lime. Borate of Lime. Datholit, W. Chaux Boratée Siliceuse, H. Chaux Datolit, Bt. Prismatic Datolite, J. Prismatic Dystome Spar, M. Esmarkite, *Hausmann.* Humboldtite, *Levy.* Vulcanus dystomus, D.

Combination of silica, boracic acid, lime, and water.

	Arendal.	Andreasberg.	Andreasberg.
Boracic acid	21·67	21·26	21·34
Silica	36·66	37·36	38·51
Lime	34·00	35·67	35·59
Water	5·50	5·71	4·60
	97·83 Vauquelin.	100·00 Stromeyer.	100·04 Du Menil.

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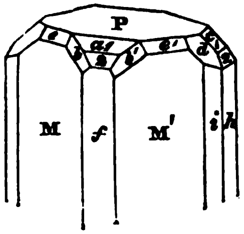
[*] Datholite, from the Greek, signifying *turbid,* in allusion to the want of transparency in the mineral.

	Andreasberg.	Arendal.
Boracic acid	20·315	21·377
Silica	38·477	37·520
Lime	35·640	35·398
Water	5·568	5·703
	100·00 Rammelsberg.*	100·00 Rammelsberg.

These last analyses by Rammelsberg and Dumenil nearly agree with the results obtained by Stromeyer, according to which Dr. Thomson has expressed the constitution of the mineral thus: $3\mathrm{CalS}^3+\mathrm{Cal}\dot{\mathrm{B}}^2+2\frac{1}{2}\mathrm{Aq}$.

Sp. Gr. 2·9 to 3·3. H. = 5·0 — 5·5.

Datholite occurs massive, and crystallized in rhombic prisms of which the lateral edges and the solid angles are commonly replaced by planes; color greyish, or greenish-white; translucent; fracture imperfectly conchoidal, with a somewhat vitreous lustre. The primary form is a Right rhombic prism of about 103° 40′ and 76° 20′, from the measurement of its natural planes by the reflective goniometer. When exposed to the flame of a candle it becomes opake, and crumbles down between the fingers; B B, it intumesces into a white mass, and then melts into a transparent or pale rose-colored globule. It dissolves readily in, and gelatinizes with, nitric acid.



P on M or M′	90°	00′
M on M′	103	40
M or M′ on *f*	141	48
— on *e*, or M′ on *e′*	129	5
M′ on *i*	160	45
P on *a*1	112	25
—— *c*1	147	45
—— *c*2	128	15
—— *d*	140	00
—— *e* or *e′*	140	55
—— *h* or *i*	147	50
—— *d* or *c*1	157	00
—— *f* or *a*2	141	00 *c. g.*

It occurs at Arendal in Norway; at Andreasberg in the Hartz; in the island of Uton in Sweden; and in the valley of Glen Farg in Perthshire.

In the United States the trap rocks of Connecticut and New Jersey, have furnished very beautiful crystallizations of this mineral. It is found at Hartford, Middlefield, Cheshire, and at one or two other places in the former state; sometimes in a massive fibrous form, (botryolite). At Patterson and Bergen, N. J., the crystals, though usually highly modified, have

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† Berzelius' Rapport Annuel, 1840, p. 136. Rammelsberg's Handwörterbuch, 1st part, page 183.

exhibited the primary planes almost entire. It is here associated with calc spar, apophyllite, analcime and stilbite. According to Prof. Beck, small crystals presenting the primary form only slightly modified, occur in gneiss near Yonkers, West Chester county, N. Y.

Botryolite occurs in mamillary concretions formed of concentric layers, having a splintery or fibrous texture; it is brittle, translucent on the edges, and externally of a pearl- or yellowish-grey color; internally white, greyish, and red in concentric circles. It also occurs in small botryoidal* masses, which are white and have an earthy texture. B B, it melts into a white glass. Its locality is Arendal in Norway, where it forms in a bed in gneiss, accompanied by schorl, magnetic iron ore, and iron pyrites. According to M. Rammelsberg, (*Berzelius' Rapport Annuel*, p. 136, 1840,) it is generally mixed with carbonate of lime, and when this is removed, the analysis of the mineral gives silica 36·90, boracic acid 18·34, lime 34·27, water 10·22. It differs from crystallized datholite in containing one atom more of water.

Humboldite. The small, brilliant transparent crystals of this mineral from the Seisen Alps in the Tyrol, have been examined by M. Levy, and supposed not to be derived from a *Right* rhombic prism, but from an *Oblique* rhombic prism. He has hence considered it as a new species under the name of Humboldite. But no analysis has been made of these crystals, and the specific distinction supposed to exist by M. Levy is not generally admitted.†

BARYTO-FLUATE OF LIME.

Dr. Thomson, (*Outlines*, &c., i. p. 142.)

This mineral occurs in Derbyshire, constituting a bed an inch thick in a slaty limestone. In appearance it is very similar to grey compact limestone. Its specific gravity is 3·75. It was analyzed by Smithson, who found it composed of sulphate of lime 51·5, fluoride of calcium 48·5: corresponding with one atom sulphate of barytes and three atoms fluoride of calcium.‡ Formula: $3\mathrm{Cal}\dot{\mathrm{F}}\mathrm{l}+\mathrm{Br}\dot{\mathrm{S}}$.

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* Whence botryolite, from the Greek; in allusion to the resemblance in form to grapes.

† Mr. Brooke (Ency. Metrop., Art. Min. p. 502.) thinks that Levy was deceived by the imperfection of the crystals examined by him, and that both minerals agree in form and measurement.

‡ Schweigger's Jahrbuch, i. 362.

PHARMACOLITE.*

Arseniate of Lime. Arsenikblüthe, W. Chaux Arseniatée, H. Pharmacolite, J. Hemi-prismatic Gypsum Haloide, *Haidinger*. Gypsalus stellalus, D.

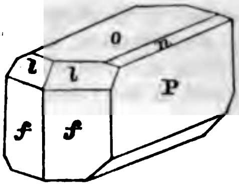
Combination of arsenic acid, lime, and water.

	Wittichen.	Andreasberg.
Arsenic acid	50·40	45·68
Lime	25·00	27·28
Water	24·46	23·86
	100·00 Klaproth.	96·82 John.

The pure crystals of this mineral analyzed by the late Dr. Turner, were composed of arseniate of lime 79·01, water 20·99, or of one atom of the former, and two and a half atoms of the latter. Formula: $Cal\dot{A}s+2\frac{1}{2}Aq$.

Sp. Gr. 2·64—2·8. H. = 2·0—2·5.

The pharmacolite is found in minute fibrous or acicular crystals, which commonly are aggregated into botryoidal or globular masses, having a glimmering or silky lustre; more rarely in modified crystals, the primary form of which is supposed to be a Right rhombic prism. Cleavage parallel to P, highly perfect and easily obtained. Its color is white or greyish-white; but the *surface* is often tinged of a red or violet color by arseniate of cobalt. B B, it is almost entirely volatilized, with a dense white arsenical vapor. In nitric acid it dissolves readily without effervescence.



f on *f*	117° 24′
o to the edge between *f* and *f*	83 14

Pharmacolite occurs at Andreasberg in the Hartz; at Riegelsdorf, and Glucksbrunn in Thuringia; at St. Marie-aux-Mines in the Vosges, in minute silky white crystals; and at Wittichen, near Furstenberg in Germany, disseminated on granite, in a vein containing cobalt, barytes, and sulphate of lime. Clear transparent crystals of pharmacolite, very distinctly pronounced, and fully a line in diameter, were at one period found in the Grand Duchy of Baden, probably at Badenweiler, and of these some fine specimens are preserved in the palace at Carlsrhue.

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* Pharmacolite, from the Greek; in allusion to its containing poison.

The *Picro-pharmacolite* of Stromeyer, from Riegelsdorf in Hessia, contains about three per cent. of magnesia, but in other respects corresponds with this mineral.

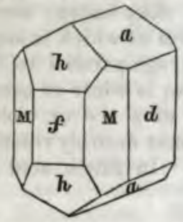
HAIDINGERITE.*

Diatomous Gypsum Haloide, *Haidinger*. Gypsalus rhombicus, D.

It is composed by the analysis of Turner, of arseniate of lime 85·68, water 14·32; or it is a sesquihydrous arseniate of lime, containing one atom less of water than the last described species. Formula: $Cal\dot{A}s+1\frac{1}{2}Aq$.

Sp. Gr. 2·84. H. = 2·0 — 2·5.

Primary, a Right rhombic prism; color white and transparent, with a vitreous lustre, and white streak. Cleavage highly perfect and easily obtained parallel to *d*. Readily soluble in acid. Thin laminæ slightly flexible.



M on M	100°	0′
a on *a* over the terminal edge . .	126	58

This very rare mineral was distinguished by Haidinger from the pharmacolite of Baden, which it accompanies, and with which it used to be confounded. Its form and lustre are distinct, and it occurs in crystals aggregated in botryoidal form.

OXALATE OF LIME.

H. J. Brooke. (*Lond. and Edinb. Phil. Mag.* xvi. p. 449, 1840.)

Mr. Brooke on examining some specimens of carbonate of lime supposed to be from Hungary, detected a few small crystals from one tenth to one fourth of an inch long, which, on examination by Mr. Landall, proved to be oxalate of lime with one proportional of water.

Sp. Gr. 1·833. H. = rather than less calc-spar.

It possesses a high metallic lustre, similar to that of sulphate of lead. Is very brittle; fracture being conchoidal. Is colorless, and transparent to opake. Its primary form is an Oblique rhombic prism (see fig. 12, p. xi. of the Introduction to this volume,) the secondary modifications of which are shown

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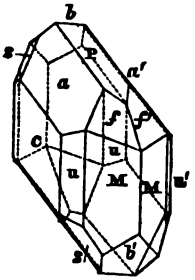
[*] In honor of its discoverer, Wm. Haidinger, Esq. Brewster's Journal, iii. 303; and Poggendorf's Annalen, v. 189.

on the subjoined figure as given by Brooke. Cleavage parallel to P, M and to *c*.



P on M	108°	14'
P on *a*	127	25
P on *c*	90	00
P on *b*	109	28
P on *s*	136	48
P on *f*	148	4
a on *s*	154	19
a on *f*	148	18
a on *c*	142	36
a on *b*	101	41
M on M'	100	36
M on *u*	160	45
M on *c*	129	42
M on *a*	111	37
M on *b'*	128	4
M on *s*	136	48
M on *f*	142	15*

Most of the crystals are twins, and remarkably symmetrical in their forms. All the planes are bright and perfect except M, which is striated by its alternations with *u*; and *f*, which is also striated parallel to the edge between *f* and *f'*. Mr. Brooke observes that their crystals appear to have been formed contemporaneously with those of the calc-spar, in which some of them are imbedded; a circumstance which excludes the supposition of their being of vegetable origin. As only one other oxalate, that of iron, is known to exist in the mineral state, and as it occurs in a bed of wood coal, and the oxalic acid contained in it may be presumed to have been derived from vegetable matter, this oxalate of lime affords the first instance of the occurrence of oxalic acid as a distinct mineral product.

TUNGSTATE OF LIME.

Pyramidal Scheelium Baryte, M. Tungsten † Schwerstein, W. Scheelin Calcaire, H. Pyramidal Tungsten, J. Scheelite,‡ *Necker*. Scheelius pyramidalis, D.

Combination of tungstic acid and lime.

	Sweden.	Huntington, Conn.	Schlackenwald.	Zinwald.
Tungstic acid	80·42	76·05	78·00	76·50
Lime	19·40	19·36	19·06	16·50
Oxide of iron	0·00	1·03	0·00	1·47
Silica	0·00	2·54	2·00	2·94
Alumina	0·00	0·00	0·00	1·09
	99·82 Berzelius.	99 98 Bowen.§	99·66	98·50 ‖

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* For these measurements Mr. Brooke acknowledges himself indebted to Prof. Miller, of Cambridge.

† Tungsten, German; a heavy stone.

‡ In honor of Scheele, who first accurately investigated this mineral, and discovered tungstic acid.

§ Amer. Jour. of Science, v. p. 118.

‖ These last two analyses are by Bucholz and Brandes. Schweigger's Journal, xx. 285.

The results of these several analyses approach very nearly one atom tungstic acid and one atom lime. The constitution of this mineral is therefore thus expressed: $\mathrm{Cal}\dot{\mathrm{T}}\mathrm{n}$.*

Sp. Gr. 6·0 — 6·1. H. = 4·0 — 4·5.

Tungsten has a greyish and yellowish-white color, and occurs both crystallized and amorphous; the crystals present the form of a four-sided pyramid, approaching nearly to the octahedron. Two of the lateral angles are often replaced by the faces of another pyramid considerably more acute (fig. 1.); the angles formed by the meeting of a plane of the upper with the adjoining plane of the lower pyramid, being, according to the measurements annexed to the following figure, 128° 40′. It yields to cleavage parallel to the faces of both pyramids (figs. 1 and 3), with a somewhat shining lustre; it is translucent generally only on the edges. B B, it crackles and becomes opake, but does not melt, except that the thinnest edges are converted, at a high temperature, into a semi-transparent vitrified mass: with borax it yields a white glass; and with salt of phosphorus melts in the oxidating flame into a transparent colorless globule, and in the reducing flame, into a green globule, which becomes of a fine blue color on cooling. When pulverized and thrown into heated nitric acid, it assumes a yellow color, but does not dissolve. Fragments dropped upon live coal exhibit a phosphorescent light.

This mineral, when massive, considerably resembles carbonate and sulphate of lead, and also barytes. It may be distinguished from the two first by its not effervescing in acids; from the last by the yellow color which it assumes when placed in nitric acid.

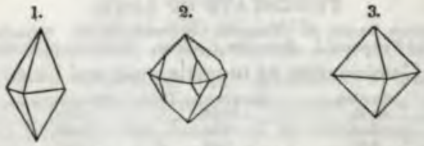

Fig. 1, the primary; an acute four-sided pyramid. Fig. 2 represents the usual form in which this substance occurs; its larger faces arise from the deep replacement of the pyramidal edges of fig. 1, by planes which are parallel therewith; those of the primary crystal being thus reduced to small triangles. The replacing planes of fig. 2 are complete in fig. 3, forming a pyramid which is less acute than the primary.

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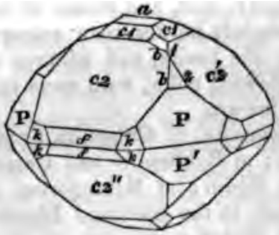
* $\mathrm{Cal}\dot{\mathrm{T}}\mathrm{n}$, or $\dot{\mathrm{Ca}}\dddot{\mathrm{W}}$, according to the chemical formula of Berzelius, require 19·36 of lime, and 80·64 of tungstic acid, numbers which are almost exactly supplied by Berzelius' own analysis of a very pure specimen, as given in the first column. [Am. Ed.]



P on P'	128°	40'	
P on P	100	40	
—— b	137	30	B.
—— b2	150	34	
—— c2 or c2'	136	28	
—— or P' on f'	140	20	
P on k or P on k	152	10	
c1 on c1 over a	95	00	B.
c2 on c2'	129	40	
c2 or c2' on b2'	153	30	
c2 on f	160	50	
f on k or k'	152	55	

The above figure (with the exception of the upper planes, which are given on the authority of Bournon) was taken from a crystal in the possession of Mr. Sowerby.

This mineral occurs both crystalline and amorphous, particularly in the repositories of tin ore at Schlackenwald and Zinnwald in Bohemia; the crystals from these localities are occasionally of large dimensions; the most symmetrical, however, are found associated with apatite, molybdena, and wolfram, in quartz, at Caldbeckfell in Cumberland. Sweden, Dauphiné, and Cornwall, are other localities of this species.

The only localities of this species in the United States, are Munroe, Conn., where it occurs massive and in irregular crystals in quartz associated with wolfram and native bismuth; and Trumbull, in the same State, near the topaz locality.

CARBONATE OF MAGNESIA

Magnesite, ***Jameson.*** **Bandisserite. Razoumoffskin. Magnesiakes fibrosus, D.**

	Styria.	Salem.	India.	India.
Magnesia	48 0	47·68	46·00	48·03
Carbonic acid	49.0	51·82	51·00	51·35
Water	3.0	0·00	0·50	0·00
Insoluble matter	0.0	0·00	1·50	0·00
	100·0 Klaproth.	99·70 Stromeyer.	99·10 Henry.	99·38 Thomson.

It is composed of one atom carbonic acid and one atom magnesia, or by weight of 52·38 acid, 47·62 base; numbers which nearly accord with the mean of the above analyses of the mineral, there being a slight deficiency of the acid. But the late analysis of a specimen by Rammelsberg, gives these proportions almost exactly, viz. carbonic acid 52·21, magnesia 47·79.* Specific gravity 2·8.

Magnesite occurs massive, amorphous, and reniform; one variety, from Salem in the Carnatic, presents occasionally slight indications of crystallization. The fracture is splintery or flat conchoidal; it is nearly opake, dull, and yields to the nail externally, but internally is slightly harder than calcareous spar; is somewhat meagre to the touch, and adheres to the tongue. It is of a grey or yellowish color, with spots and dendritic delineations of blackish-brown.

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* Handwörterbuch des chemischen Theils der Mineralogie, ii. p. 397.

It occurs in serpentine, with bronzite, at Gulsen in Upper Styria; at Hrubschitz in Moravia; at Baldissero and Castellamonte in Italy; at Vallecas in Spain; at Baumgarten in Silesia. It occurs also in Scotland, in the Shetland Islands, and near Madras. In the United States specimens of great purity are obtained in large quantities in the serpentine at the Bare Hills, near Baltimore, and in the same rock at Hoboken, N. J.

Earthy Carbonate of Magnesia. Meerschaum, W. Ecume de Mer, Br. Meerschaum is of a white or yellowish color; opake and dull; it has an earthy fracture, yields easily to the nail, and adheres to the tongue; sometimes is so light as to swim on water, and occasionally is very porous. It consists of 45·42 magnesia, 47 carbonic acid, 4·5 silica, 2 water, 0·5 alumina, with traces of manganese and lime. — *Tromsdorff.*

It occurs in the isles of Samos and Negropont in the Archipelago, in mass, or disseminated, or in beds; and at Kiltschik in Natolia. It is soft when first dug, and in that state is made into pipes, but hardens on exposure to the air. It is also met with in Carinthia, Moravia, and Spain; and is mentioned as occurring in veins in the serpentine of Cornwall.

In the Turkish dominions Meerschaum is employed as fuller's earth; and it is well known as the material used in the manufacture of Turkish pipes.

BREUNNERITE *

Breunnerite, A. Carbonate of Magnesia and Iron. Brachytypous Lime Haloide, M. Spath Magnesian, *Necker.* Magnesialus rhombohedrus, D. Giobertite, *Beudant.*

Consists of carbonate of magnesia, with carbonate of iron and manganese.

	Tyrol.	Zillerthal.	Fassathal.	Pfitschthal.
Carb. of magnesia.	86·05	84·79	82·99	82·99
Carb. of iron	13·15	13·82	16·97	15·59
Carb. of mangan.	0·00	0·69	0·78	1·19
	99·20 Brooke.	99·30 Strom.	100·64 Strom.	99·69 Magnus.

By Necker and Beudant this species is united with the last, but the iron seems to be an essential ingredient, and entitles it to the character of a distinct species.

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* In honor of Count Breunner of Austria.

Sp. Gr. 3·0 — 3·2. H. = 4·0 — 4·5.

Primary form an Obtuse rhomboid of 107° 30′, according to Brooke. Occurs in single, yellowish or brown, translucent crystals; lustre vitreous, sometimes inclining to pearly; cleavage perfect parallel to the faces of the rhomb; fracture flat conchoidal. Soluble without effervescence in nitric acid. The best known localities of this mineral are the Rothen-Kopf and Greiner Mountains in the Zillerthal, Tyrol, where it occurs imbedded in chlorite slate, and associated with bitter spar, from which, however, it may be distinguished by its color, — the breunnerite being brown or yellow, whilst the other is white and translucent. Under similar circumstances it is met with imbedded in green foliated talc on the island of Unst in Shetland. — *Allan's Manual.*

The rhombohedral crystals imbedded in the steatite at Marlboro', Vt., at Middlefield, Mass, and Smithfield, R. I., appear to belong to this species. It occurs also similarly associated in other parts of the country.

CONITE.

Conite, *Friesleben*, J.

Sp. Gr. 3·0. Scratches glass.

Amorphous, massive, and in crusts. Color flesh-red, externally coated with iron ochre. Devoid of lustre. Opake. Brittle. Fracture sometimes fine grained or imperfectly conchoidal. Consists of Carbonate of magnesia 67·5, carbonate of lime 28·0, oxide of iron 3·5, water 1·0. — *John.*

It occurs in Iceland, on the Meissner in Hessia, and in Saxony. It has been usually described as a variety of dolomite, but as it possesses a greater degree of hardness, and differs considerably in its composition from that mineral, it may prove to be a new species.

SULPHATE OF MAGNESIA.

Epsomite, *Beudant.* Naturlicher Bittersalz, W. Magnesie Sulphatée, H. Sel d'Epsom Natif, Br. Prismatic Epsom Salt, M. J. Picralum rhombicum, D.

Combination of sulphuric acid, magnesia, and water.

		Catalonia.
Sulphuric acid	32·57	32·53
Water	51·43	51·43
Magnesia	16·00	16·04
	100·00 Berzelius.	100·00 Gay-Lussac.

Formula: $\mathrm{Mg\dot{S}l}+7\mathrm{Aq}$.

Sp. Gr. 1·66 to 1·75.

Primary form a Rhombic prism of 90° 30′ and 89° 30′. It occurs in crystalline fibres, rarely pulverulent; color white or grey, transparent or opake; very brittle; its taste bitter and saline. Soluble in less than double its weight of cold water.

This salt forms the principal ingredient of several mineral waters, and is a product of the decomposition of certain rocks, upon the surface of which it appears in efflorescences. In the former state it is obtained at Epsom in Surrey,—hence its name; and in the latter it occurs in the old coal wastes or alum mines of Hurlet near Paisley; in the quicksilver mines of Idria; on gypsum in the quarries of Montmartre near Paris; and on the surface of the soil in many parts of Spain, and in Peru; where according to Mr. Blake, it forms a large bed near Arequipa, and is often in crystals and in silky fibres, possessing great beauty. Also in Chili it exists in the waters of several springs particularly near Santiago. It occasionally exhibits a fine fibrous texture.

In Sevier county, Tenn., according to Dr. Troost, this salt occurs as an efflorescence, or in fibrous crystalline masses in the cavities of slate rocks. In Oregon, Mr. Parker observed immense quantities of this salt in the neighborhood of the Rocky Mountains, where it forms an efflorescence to such an extent that the fields appear white like snow.

NITRATE OF MAGNESIA.

Nitro-Magnesite, *Sheperd*. Magnesie Nitratée, *Necker*. Picralum deliquescens, D.

Contains nitric acid 72·0, magnesia 28·0.—*Wenzel.*

Color white; is usually met with in a deliquescent state, mixed with nitre and nitrate of lime, on old walls and in limestone caves.

WAGNERITE.

Hemi-prismatic Fluor Haloide, *Haidinger*. Magnesie Phosphatée *of the French*. Wagnerit, *Fuchs*. Pleuroklas, *Breithaupt*. Phosphorsaurer Talk, *Leonhard*. Fluellus obliquus, D.

It is composed, according to the analysis by Fuchs, as follows. It is not certain which are to be regarded as the essential constituents. Supposing only the phosphoric acid and magnesia to be essential, its constitution is one atom of the former, to two atoms of the latter.

Phosphoric acid	41·73
Magnesia	46·66
Oxide of iron	5·00
Oxide of manganese	0·50
Fluoric acid	6·50
	100·39 Fuchs.

Sp. Gr. 3·11. H. = 5·0 — 5·5.

Primary form an Oblique rhombic prism 95° 25′ and 84°

35′, whose base is inclined to its planes at an angle of 109° 20′. In crystals extremely complicated. Color yellow of different shades, often inclining to grey. Translucent. Streak white. Lustre vitreous. Most of the planes of the prism are deeply striated. Fracture uneven and splintery. B B, *per se*, it fuses with difficulty into a dark greenish-grey glass; with borax and salt of phosphorus, however, it is readily and entirely dissolved. From its powder digested in the nitric or sulphuric acids, fluoric acid fumes are given off.

It occurs in the valley of Holgraben, near Werfen in Saltzburg, in irregular veins of quartz, traversing clay-slate; but it is an extremely rare mineral.

BORACITE.

Borate of Magnesia. Boracit, W. Magnesie Boratée, H. Tetrahedral Boracite, M. Hexahedral Boracite, J. Biborate of Magnesia, *Thomson*. Boracius hemihodrus, D.

Combination of boracic acid and magnesia, occasionally mixed with lime and a little silica.

	Luneburg.	Segeberg.	Schildstein.
Boracic acid	69·70	63·07	64·14
Magnesia	30·30	36·03	31·11
Silica	0·00	0·00	0·50
Oxide of iron	0·00	0·00	1·50
	100·00 Arfwedson.	99·10 Pfaff.	67·25 Dumenil.

	Transparent crystals.	Opake crystals.
Boracic acid	69·252	68·876
Magnesia	30·748	31·124
	100·000 Rammelsberg.*	100·000 Rammelsberg.

The numbers furnished by the analyses of Arfwedson and Rammelsberg approach very nearly to those required by the formula $Mg\dot{B}^3$, or 70·588 of boracic acid, and 29·412 of magnesia. It is therefore a biborate, or consists of two atoms (6) acid, and one atom (2·5) of base, as above expressed.

Sp. Gr. 2·56 — 3·0. H. = 7·0.

It occurs only crystallized in the general form of the cube, of which the edges are replaced, and the diagonally opposed solid angles dissimilarly modified; the cube is considered by Haüy its primary form, but it exhibits an imperfect cleavage parallel to the faces of the octahedron; fracture uneven, or imperfectly conchoidal, with a glistening lustre; more or less translucent; is hard enough to give sparks with the steel, and is of a yellowish-, greyish-, or greenish-white. The opake white crystals are not so hard, and contain a proportion of carbonate of lime. B B, on charcoal, it fuses and intumesces. It is difficult to obtain the globule transparent. On cooling, it is bristled over with needle crystals. With borax it fuses into a transparent glass tinged with iron. With biphosphate of soda it fuses into a transparent glass, capable of becoming opake by flaming. With carbonate of soda it fuses. If only the quantity necessary to procure a transparent glass be used, the assay on cooling forms crystals with broad facets as perfect as those of phosphate of lead.* It is remarkable that the diagonally opposed solid angles, on the application of heat, become, the one positive electric, the other negative.

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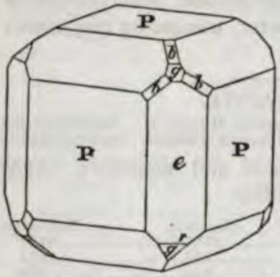
* Poggendorf's Annalen, xlix. 45; or Rammelsberg's Handwörterbuch, i. 119.



P on P . . .	90°	00′ H.
—— *g* . . .	125	15
P or P̄ on *e* .	135	00
—— *b*	144	44

Until recently it has been found only in gypsum at the Kalkberg near Luneburg, and at Segeberg near Kiel in Holstein, in small but very perfect isolated crystals. In the southern part of Peru, near Tarapaca, it is crystallized, imbedded in gypsum, and in rolled masses scattered through the plain. — *Blake.* It has not been met with in the United States.

HYDRO-BORACITE.

Gypsalus fusilis, D. *Hess*, (*Poggendorf's Annalen*, xxx. 49.)

Composition according to two analyses by Von Hess, as follows:

Boracic acid	49·922	49·22
Lime	13·298	13·74
Magnesia	10·430	10·71
Water	26·330	26·33
	100·000	100·00

Dr. Thomson makes it a hydrous calcareo-biborate of magnesia, thus atomically expressed: $\mathrm{Cal}\dot{\mathrm{B}}^2+\mathrm{Mg}\dot{\mathrm{B}}^2+5\frac{1}{2}\mathrm{Aq}$.

Occurs in small needle crystals which seem to be flat six-sided prisms, which are elongated or consist in part of tangled fibres; contains spots on cavities filled with ferruginous alumina. Color snow-white; translucent; in spots red and brown with oxide of iron. In platina tongs swells up, becomes white and fuses to a clear yellowish-white vitreous globule, the flame being colored green. In the alembic it decrepitates, becomes snow-white and opake, gives much water, by which litmus paper is reddened a little. On charcoal, becomes snow-white, and fuses with intumescence into a yellowish glass, which, as long as it is hot, is of a wine-yellow color, but on cooling, becomes light. With borax or salt of phosphorus it dissolves, and gives a colorless vitreous globule. With a little soda it fuses immediately, with strong intumescence, into a transparent yellowish globule; with excess of soda becomes opake and milk-white; with more soda spreads on the charcoal, and becomes, on cooling, white and crystalline. Hydro-boracite was named by V. Hess, on account of the large quantity of water united with the other constituents. It was taken by Gebhard for gypsum. It is slightly soluble in water, and readily in acids, the saturated solution yielding crystallized boracic acid on cooling. It was first noticed by Von Worth in a collection of Caucasian minerals.

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* Berzelius on the Blowpipe, p. 236.

CARBONATE OF BARYTES.*

Witherite,† W. Baryte Carbonatée, H. Diprismatic Hal Baryte, M. Rhomboidal Baryte, J. Barolite. Baralus fusilis, D.

Composed as follows:

	Alston Moor.	England.	Styria.
Carbonic acid	21·4	22.5	22·0
Baryta	78·6	77·1	78·0
	100·0 Withering.	99·6 Beudant.	100·0 Klaperth.

It is thus shown to be a pure carbonate of barytes, consisting of one atom acid, and one atom barytes. Formula; $Br\dot{C}$.

Sp. Gr. 4·3. H. = 3·0 — 3·5.

It occurs massive, stalactitic and crystallized; the structure of the massive is fibrous; the crystals in their general form resemble the common variety of quartz, namely, a six-sided prism terminated by six-sided pyramids; but by the assistance of the reflective goniometer, it is found that the measurements are not those of a regular six-sided prism; being on the lateral planes (M on M′) only 118° 30′; hence these crystals may be considered as macles, analogous to the artificial crystals of sulphate of potash, their primary form being a Right rhombic prism. Occasionally a re-entering angle is observable on the alternate planes of the prism, as in the following figure, in which case the crystal is a macle in a double sense. Internally translucent, with a glistening lustre; externally the small crystals are shining, the larger opake; generally white, sometimes greyish or greenish. Exposed in the platina forceps to the blowpipe, it melts readily and with a brilliant light into a white enamel: it is soluble slowly and with feeble effervescence in dilute muriatic or nitric acid.

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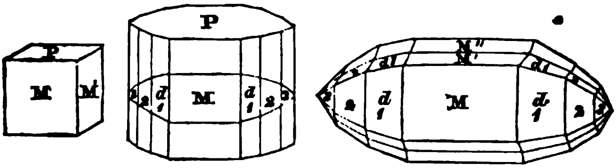
* Barytes, from the Greek, signifying *heavy* — in allusion to the great specific gravity of the earth.

† Witherite, after Dr. Withering, its discoverer.



The first figure represents the primary form, a right rhombic prism of which, in the second figure, the lateral edges are replaced (the plane M', totally disappearing) by the planes *d*1, 2, and 3, and the dotted lines include one, of several similar portions, contributing to form the macled crystal on the right of it.

M on M'	118° 30'
—— *d*1 or *d*1'	145 30
—— *d*2 or *d*2'	126 16
—— *d*3 or *d*3'	110 30
M' on M'' (re-entering angle)	175 30

It was first noticed by Dr. Withering, at Anglesark in Lancashire, in a vein, with sulphuret of lead and some of the ores of zinc, in globular concretions having a radiated structure. It occurs abundantly in the lead veins of the north of England, generally in botryoidal and reniform concretions, but of late years also in large transparent crystals. It has likewise been found in Styria, in Salzburg, Sicily, and the Altai Mountains in Siberia, but nowhere so abundantly as in England. This mineral is said to have been found many years since near Lexington, Ken., but at present we have no knowledge of its existence in the United States.

BARYTO-CALCITE.

Baryto-calcite, *Brooke.* (*Ann. of Phil.*, xliv. 114.) Hemi-prismatic Hal-baryte, M. Calcareo-carbonate of Barytes, *Dr. Thomson.* Baralus obliquus, D.

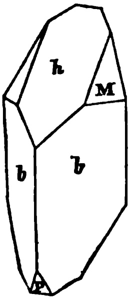
Composition, according to the analyses of Children and Richardson;

		Alston Moor.
Carb. of barytes	65·9	62·20
Carb. of lime	33·6	31·65
Sulph. of barytes	00·0	0·30
Peroxide of iron	00·0	0·65
Water	00·0	3·45
	99·5 Children.	98·45 Richardson.

Reduced to the atomic constitution, the mean of these numbers affords 5·23 atoms carbonate of barytes, 5·19 atoms carbonate of lime; or the mineral is a compound of one atom of each of these constituents. Formula: $Cal\dot{C}+Br\dot{C}$.

Sp. Gr. 3·6 — 3·7. H. = 4·0.

Primary form an Oblique rhombic prism, M on M 106° 54′, P on M 102° 54′.



M on M over the face *h*	106° 54′	— Brooke.
b on *b*	95 15	
h on the edge between *b* and *b*	119 00	
P on the same edge	135 00	

Cleavage perfect and easily obtained parallel to the faces M and P. Occurs both crystallized and massive; and of a white, yellow, or greyish color. Transparent or translucent, with a vitreous or resinous lustre, and white streak. B B, *per se*, it does not fuse; but with borax, in the oxidating flame, affords a diaphanous globule of a light amethystine tinge, which becomes colorless in the reducing flame, to which it communicates a yellowish-green color. It effervesces briskly in nitric or muriatic acid.

Alston Moor, in Cumberland, is the only known locality of baryto-calcite. In the lead mines there, it occurs in considerable quantity, and occasionally in crystals which exceed an inch in length; but the larger crystals often suffer decomposition, and are converted into a white mealy-like mass resembling barytes.

BROMLITE.

e. *Dr. Thomson.* (*Lond. and Edinb. Phil. Mag.*, xi. 48, 1837.) Bicalcareo-car-ate of Barytes, of the second analysis. New Baryto-calcite of Prof. Johnston.

e have three analyses of this mineral, one by Prof. J. . Johnston, and two by Dr. Thomson, but they give very ent results, as here shown:

	Fallowfield.	Bromley Hill.	
bonate of barytes	62·156	49·31	60·63
bonate of lime	30·290	50·69	30·19
bonate of strontian	6·641	0·00	0·00
bonate of manganese	0·000	0·00	9·18
	99·078 Johnston.	100·00 Thomson.	100·00 Thomson.

cording to the first analysis, the mineral seems to agree y in composition with baryto-calcite, and Prof. Johnston, ingenious article founded on his own analysis,* supposes aryto-calcite to be a *dimorphous* mineral, while the carbo-of strontian exists in it as an isomorphous constituent. 'homson's first analysis gives exactly two atoms carbonate ne to one atom of carbonate of barytes, whence its name *'areo-carbonate of barytes.* But by a subsequent and careful analysis, he has obtained the results above stated, ie supposes the manganese to have been previously over-d both by Prof. Johnston and himself.† It thus appears to triple salt. Formula: $4Br\dot{C}+4Cal\dot{C}+\underline{Mn}\dot{C}$.

Sp. Gr. 3·718. H. = 2·25.

lor snow-white; translucent, lustre vitreous, fracture in 'al granular and uneven; in one instance it presented the

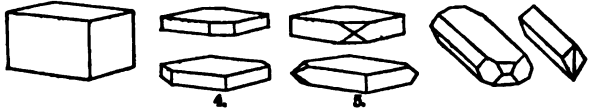
	Frieberg.	Stienmark.	Klausthal.	Schoharie, N. Y.
Sulphate of barytes	97·50	90·00	86·00	90·37
Sulphate of strontian	0·80	0·00	6·75	0·00
Silica	0·00	10·00	5·75	9·63
Water	0·70	0·00	0·37	0·00
	99·00 Klaproth.	100·00 Klaproth.	98·87 Jordan.	100·00 Macneven.

A very pure specimen analysed by Stronmeyer, gave sulphate of barytes 99·37, with a small portion of water and oxide of iron. Formula: $Br.\dot{S}$.

Sp. Gr. 4·41 to 4·67. H. = 3·0 — 3·5.

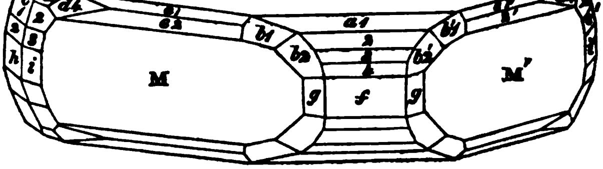
It occurs both massive and crystallized, with a lamellar structure, which in the massive is sometimes curved; the crystals are divisible into the form of a Right rhombic prism, which therefore is the primary crystal; its angles by the reflective goniometer, from fractured surfaces, being 101° 42′ and 78° 18′: the lustre of the fragments is shining. It occurs transparent and opake; white, yellow, red, grey and blue; it possesses double refraction when held in a particular direction. It decrepitates briskly, and is difficultly fusible, but eventually melts into a hard white enamel, which is not affected by acid. B B, communicates to the flame a pale yellowish green color.

1. Primary. 2. 3. 6. 7.



4. 5.

Fig. 1, the primary—a right prism with rhombic bases. Fig. 2, the same; of which the obtuse edges are replaced by planes parallel with those edges. Fig. 3, the same; of which each obtuse solid angle is replaced by a triangular plane. In fig. 4, each acute edge of the prism is replaced by a quadrangular plane. In fig. 5, all the acute solid angles are replaced by triangular planes, which, in fig. 6, are so greatly increased as to give the crystal a prismatic form: in this figure the triangular planes of fig. 3 are also visible. In fig. 7, the triangular planes of fig. 5 are so greatly increased as entirely to replace the primary terminal plane, and to reduce the primary lateral planes to small triangles. Haüy has given figures of upwards of 70 different modifications of the primary form of this mineral.



P on *a*1	173°00′ *e. g.*	M or M′ on *i*	160°00′
— — *a*2	161 00 *c. g.*	— — — on *h*	128 55
— — *a*3	141 10	— — — on *d*3	141 00
— — *a*4	121 55	— — — on *d*2	154 00
— — *c*1	127 12	— — — on *d*4	126 00
— — *d*2 or *d*2′	124 00 *c. g.*	— — — on *f*	140 50
— — *d*3 or *d*3′	110 30	— — — on g	166 00
— — *d*4	143 00	*f* on g or g′	153 00 *c. g.*
— — *e*1 or *e*1′	125 00	— — *a*4	148 10
— — *e*2 or *e*2′	115 30	— — *a*3	128 50
— — *f*	90 00	*h* on *i*	153 00 *c. g.*
— — *h*	90 00	*c*1 on *d*2	155 00 *c. g.*

Barytes is a very widely diffused species, and is also one which presents great variety of crystalline form. In the size and beauty of its specimens, the most noted locality is Dufton in Cumberland, where perfect crystals exceeding half a cwt. have occasionally been met with. Many elegant forms, though on a smaller scale, occur at Przibram and Mies in Bohemia. Crystals of large dimensions, and exhibiting splendid colors, are met with at Felsobanya and Cremnitz in Hungary; while at Roya and Raure in Auvergne the form represented by fig. 7 is of general occurrence. The deposits of this species in America, particularly the uncrystallized varieties, are very numerous. In the United States there are several localities which have furnished interesting crystallized specimens of this mineral, comprising many of the forms figured and described under distinctive names by Haüy. These are principally in New York in the same limestone which contains the strontianite, with which it is intimately associated, and has sometimes been confounded, owing to the similarity in the form of the crystals. For figures and description of these, the student is referred to the *Mineralogy of New York*, by Prof. Beck. The same forms occur also at Cheshire, Conn., in sandstone associated with carbonate and sulphuret of copper. At Hatfield, Mass., according to Prof. Hitchcock, it forms a vein from one to four feet thick, traversing sienite, and contains galena, blende and copper pyrites. A delicate fibrous variety of this mineral occurs abundantly at Pillar's Point, Jefferson county, N. Y., of a reddish-brown and yellowish color. The compact, foliated and earthy varieties accompany the lead ores at Southampton, Mass., Perkiomen, Penn., and throughout the extensive lead mines of the Southern and Western States.

*Calstronbaryte.** Prof. Shepard† has given this name to a mineral found with heavy spar and strontianite in Schoharie county, N. Y., and from which he obtained 65 55 sulphate of barytes, or 22·30 carbonate of strontian, 12·15 carbonate of lime. These numbers give very nearly two atoms of sulphate of barytes, one atom carbonate of strontian, and one atom carbonate of lime, thus apparently forming a new definite combination of these constituents. It is thus described by Prof. Shepard: Sp. Gr. 4·20 to 4·22. H. = 3·25. Color white inclining to grey, rarely exhibiting a tinge of reddish-brown. Lustre vitreous to resinous; translucent; streak white; brittle. Occurs massive, in broad, straight, lamellar masses. Primary form a Right rhombic prism. M on M = 102° 30′ to 103°, thus differing from heavy spar. Cleavage, M on T perfect, the latter more easily obtained than the former. Its secondary crystals have not been described. From the partial examination of another specimen from this locality by Prof. Beck, in which he found the proportions of the salts which compose it to vary considerably from those above stated, he is disposed to regard the substance as a mechanical mixture, not entitled to a specific distinction.

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* Signifying the three bases which enter into the composition of the mineral.

† Amer. Jour. of Science, xxxv. 161.

The following have been described as sub-species of heavy spar: —

Columnar Heavy Spar, J. Stangenspath, W. Which occurs in rhombic prisms, generally ill defined, and aggregated laterally into columns. It is white or greenish, with a shining pearly lustre, and translucent; structure lamellar. It occurs near Freyberg in Saxony.

Bolognian Stone. Radiated Barytes. Baryte sulfatée radiée, H. Occurs in roundish masses, composed apparently of minute fibrous crystals radiating from the centre. Internally it is shining or glistening, and of a grey or yellowish-grey color; it is translucent on the edges, and the fragments are wedge-shaped and soft. It is remarkably phosphorescent when heated, and retains that property for some time even after cooling. It occurs imbedded in marl at Monte Paterno, near Bologna.*

Cawk.† Occurs massive, with a coarse earthy fracture, and is opake, rarely translucent on the edges. It is white, grey, yellow, or reddish, and is glimmering or dull, soft, and brittle. Specific gravity 4·81. It occurs in Bohemia, Saxony, the Hartz, and particularly in Staffordshire, and the lead mines of Derbyshire.

HEPATITE.‡ Baryte sulfatée fetide, H. Applies to such varieties as on being rubbed or heated emit a fetid, sulphurous, or hepetic odor, and are generally of a yellow or brown color. It consists of 85 2 sulphate of baryta, 6 sulphate of lime, 1 alumina, 5 oxide of iron, and 0·5 carbon. — *Klaproth.* It occurs at Andrarum, and Kongsberg in Norway; at Lublin in Galicia.

Barytes is one of the most common accompaniments of metallic minerals in veins, and, when associated with ores of iron, possesses a deleterious influence on the process of smelting. The pure white varieties are ground and used as a pigment, either alone or mixed with white lead; but is otherwise of no great value.

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* Whence Bolognian Stone.

† The name of Cawk is said to have been given to this substance from its resemblance to chalk.

‡ From the Greek, signifying of a liver color.

STRONTIANITE.

Carbonate of Strontian. Strontianite.* Strontian, W. Strontian Carbonatée, H. Peritomous Hal Baryte, M. Peritomous Baryte, J. Barytes rubefaciens, D.

Combination of one atom carbonic acid and one atom strontian.

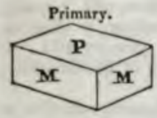
	Braunsdorf.	Strontian.
Carbonic acid	29·94	30·31
Strontia	67·51	65·60
Lime	1·28	3·47
Manganese	0·09	0·06
Water	0·07	0·07
	98·89 Stromeyer.	99·41 Stromeyer.

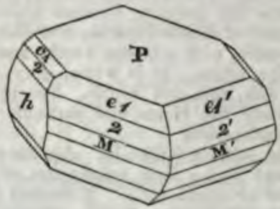
The purest specimens from Strontian, according to Dr. Thomson, contain one atom carbonate of lime; which he regards as essential, and thus gives this formula: $10Str\dot{C}+Cal\dot{C}$.

Sp. Gr. 3·6 to 3·8. H. = 3·5.

It occurs massive, fibrous, stellated, and regularly crystallized in the form of a hexahedral prism modified on the edges, or terminated by a pyramid. The primary crystal is a Right rhombic prism of 117° 32′ and 62° 28′, by measurements on planes produced by cleavage, to which the crystals readily yield parallel to the lateral faces of the prism. The structure of the massive is fibrous, sometimes divergent, with a shining pearly lustre; it is translucent, yields easily to the knife, and is brittle. Color grey, green, or brown. It is infusible B B, except on the surface, but becomes white and opake, and tinges the flame of a dark purplish-red. It is soluble with effervescence in muriatic or nitric acid; and paper dipped into the solution, and then dried, burns with a red flame.

Primary.





M on M′ .	117°	32′
—— h . .	121	30
e′ on e1′ . .	108	12
e1 on e2 or e1′ on e2′	144	20
h on c1 . .	126	5
—— c2 . .	143	20
c1 on c2 . .	160	35

This mineral was described and its properties first determined by Dr. Hope; it was discovered at Strontian in Argyleshire, in veins traversing gneiss, and accompanied by galena, barytes, calc-spar, and pyrites, in massive, stellated, fibrous, and diverging groups, but rarely presenting more than mere traces of crystallization. The finest asparagus-green as well as dark-brown fibrous varieties, are from this locality. In Yorkshire, it occurs in acute snow-white pyramids; and at Braunsdorf, in Saxony, in brilliant white and brown hexagonal prisms. The most splendid crystals of strontianite, however, have been found at Leogang in Saltzburg; but they are very rare. Very lately considerable veins of this interesting, but comparatively rare mineral, have been found near to Hamne in Westphalia, traversing rocks of the chalk series. It occurs in masses composed of granular distinct concretions, and in crystallized varieties. Color white. It yielded Prof. Becks 94·70 carbonate of strontian, 5·22 carbonate of lime.[*]

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* From its having been first found at Strontian in Scotland.

In the United States, it has been found at one or two places in New York, as at Muscalonge Lake, and Chaumont Bay; but the locality which has claimed especial attention, is in Schoharie county, the crystals from which, under their simple and compound forms, have been fully described by Prof. Shepard, in the *Amer. Jour. of Science*, xxvii. 369. It occurs also at this place in a massive form, of a pure snow-white color, and compact enough to receive a high polish. It was formerly mistaken for white marble.

EMMONSITE. Dr. Thomson has given this name, in honor of Prof. Emmons,[†] to a substance from the last named locality, and which he found to consist of carbonate of strontian, 82·69, carbonate of lime 12·50, peroxide of iron 1·00, zeolite 3·79; or of nine atoms carbonate of strontian, and two atoms carbonate of lime. Specific gravity 2·946. H. = 2·75.

Color snow-white; structure foliated, with an imperfect cleavage parallel to the face of a Right rhombic prism. It resembles gypsum, is translucent on the edges and easily reduced to powder. It is somewhat doubtful whether the carbonate of lime is any thing more than a mechanical constituent of this mineral, which is here introduced only as a variety of the present species. Other analyses will show whether the proportions above noted are constant.

BARYSTRONTIANITE.

Stromnite. (*Traill, Edinb. Phil. Trans.*, ix. 81.)

Contains carbonate of strontian 68·6, sulphate of barytes 27·5, carbonate of lime 2·6, oxide of iron 0·1, loss 1·2.—*Traill.*

Formula: $4Str\dot{C}+Br\dot{S}l+\frac{1}{4}Cal\dot{C}$.

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[*] Jameson's Edin. Jour. of Science, xxix. 417.

[†] Am. Jour. of Science, xxi. 171.

Sp. Gr. 3·7. H. = 3·5.

Occurs massive, of a greyish-white color externally, but approaching to yellowish-white internally on the fresh fracture; lustre weakly shining and pearly; translucent on the edges; brittle and soft. It effervesces with acids, but does not melt B B.

The mineral was distinguished and described by Dr. Traill, who found it in veins with galena and barytes in a kind of clay slate at Stromness[*] in Orkney. It appears to be very rare. According to Profs. Beck and Emmons, a mineral agreeing with it occurs in Oneida and Schoharie counties, N. Y.

BARYTO-SULPHATE OF STRONTIAN.

Radiated celestine, (*Dr. Thomson*, *Outlines*, *&c.*, i. 111.

Consists, according to Dr. Thomson's analysis, of

Sulphate of barytes	35·195
Sulphate of strontian	63·204
Sulphate of iron	1·241
Water	0·720
	100·360

Regarding the sulphate of iron as accidental, the mineral is composed of three atoms sulphate of barytes, and seven atoms sulphate of strontian. Formula: $7Str\dot{S}+3Br\dot{S}l$.

Sp. Gr. 3·921. H. = 2·75.

The color is white, with a very slight shade of blue. The texture is laminated, and the laminæ, which are obviously imperfect crystals, diverge as if from a central point, so as to form a kind of pencil. Brittle; very friable. B B, in the platinum forceps, becomes of a dazzling white; but does not easily fuse. Melts readily with carbonate of soda into a transparent colorless bead, which becomes white and opake on cooling. With borax it fuses very readily into a white-opake globule.

This species is found in considerable quantity in Drummond island, in Lake Erie, and also at Kingston, in Upper Canada.

CELESTINE.

Sulphate of Strontian. Zölestine. Celestin, W. Prismatoidal Hal Baryte, M. Prismatoidal Barytes, J. Strontiane Sulphatée, H. Baralus prismaticus, D.

Combination of one atom sulphuric acid and one atom strontian. But even the purest varieties are sometimes mixed with small portions of foreign matter; as shown in the following analyses. Formula: Str$\dot{S}$l.

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[*] Whence Stromnite; Barystrontianite, from its containing both baryta and strontia.

	Lake Erie.	Lake Erie.
Sulphuric acid	43 64	44·00
Strontian	56·36	54·25
Alumina	0·00	0·75
Silica	0·00	0·50
Oxide of iron	0·00	0·50
	100·00 Beudant.	100·00 Bowen.

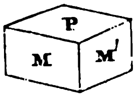
	Bristol.
Sulphate of strontian	98·35
Sulphate of lime	1·07
Moisture	0·20
Foreign matter	0·37
	99·99 Thomson.

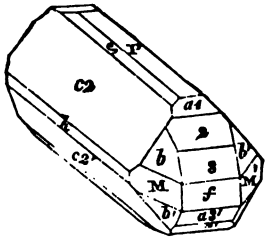
Sp. Gr. 3·6—4·0. H. = 3·0—3·5.

This mineral is white, grey, yellow, or reddish; also of a delicate blue color;* it occurs massive, fibrous, stellated, and crystallized; the primary form is a Right rhombic prism of 104° and 76°, by measurements with the reflective goniometer, from the planes produced by cleavage; the transparent crystals are pretty readily divisible into that form. It possesses a shining lustre; is translucent, transparent, or opake; and is brittle. B B, it decrepitates, and melts into a white-opake friable enamel. If a fragment of this mineral be held for some time in the reducing flame, and then moistened with a drop of muriatic acid, and held to the blue part of a candle flame, it will color the flame beautifully purple.—*Kobell.*

M on M′	104°	00′
P on M or M′	90	00
P on c1	174	32
—— c2	128	14
—— h	90	00
—— a1	157	54
—— a2	140	32
—— a3	127	48
—— f	90	00
M on b	154	2
—— f	142	5
c2 on c2′	105	20

Primary.





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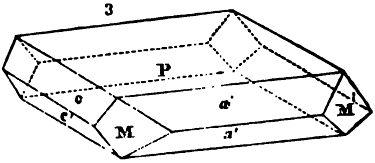

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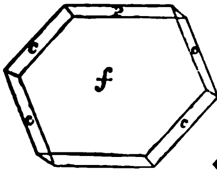

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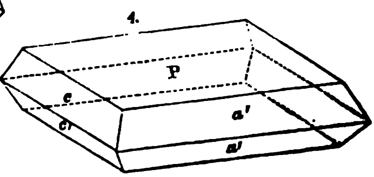

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* Sometimes approaching to sky blue, whence Celestine.

ıe sulphur mines of Sicily have long been celebrated for
magnificent groups of this substance; it there occurs in
ıatic crystals, often beautifully transparent, aggregated,
ither disposed on, or accompanied by, sulphur and gyp-
while numerous interesting forms on a smaller scale,
at Bex in Switzerland, at Conil in Spain, and in the
ntine. It is met with in straight fibrous concretions of a
color, imbedded in clay, at Dornberg, near Jena, and in
ted scopiform groups, opake and of a bluish tinge, in
lay, at Aust Ferry, near Bristol; crystalline and massive
agnesian-limestone, near Knaresborough in Yorkshire;
ted and fibrous at Norton, in Hanover (a variety which,
rding to Turner, contains twenty per cent. of sulphate of
a); fibrous and of a sky-blue color at Tornberg, Saxony;
n earthy nodules, cracked and hollow, at Monte Martre
Paris.

the United States, a very celebrated locality of sulphate
rontian, originally brought into notice by Prof. Douglas
Maj. Delafield, is at Strontian island, on the south-western
of Lake Erie. It forms a vein in secondary limestone,
is both massive, and in crystals of great size and perfec-
varying in color, as described by Major Delafield, from
-white to dark-blue and greenish-blue, in lustre, from dull
splendent, and in transparency, from the perfectly trans-
ıt to opake. The crystals present the Right rhombic
ı truncated on its obtuse solid angles, and on its terminal
s by single planes, and they are usually very much com-

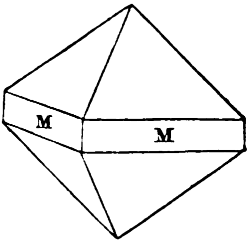
dance near the Frankstone Gap of the Alleghany Mountains, in Huntingdon county, Penn. It resembles precisely the variety from Dornberg, near Jena in Saxony. The locality extends, it is said, for fourteen miles. It is sometimes crystallized. — *J. A. Clay.* Fine crystallized celestine, according to Dr. Troost, occurs in the limestone along the Cumberland river, Tenn.

PHOSPHATE OF YTTRIA.

Berzelius, (*K. Vet. Acad. Handl.* 1824.) Phosphorsaure Yttererde, L. Xenotime, *Beudant.* Phosphyttria, *Berzelius.* Tankelite. Yttria Phosphatée, *Necker.* Spanialus peritomus, D.

Composed, according to Berzelius, of phosphoric acid and a little fluoric acid 33·49, yttria 62·58, diphosphate of iron 3·93. It is a subsesquiphosphate of yttria. Formula: $Y^{1\frac{1}{2}}\dot{P}$.

Sp. Gr. 4·14 — 4·55. H. = 4·5 — 5·0.



Primary form, a Right square prism. Secondary form like the adjoining figure in which it usually occurs. M on the faces of the pyramids about 135°.

Color yellowish-brown; with a resinous lustre; and pale brown streak. Cleavage perfect parallel to M; fracture uneven and splintery; nearly opake. B B, it does not in the matrass yield water. On charcoal *per se*, it is infusible; with borax it affords a colorless bead, which becomes milky on cooling; with salt of phosphorus it is difficultly soluble into a colorless glass; and with boracic acid and iron wire, yields phosphuret of iron. Insoluble in acids.

This mineral occurs in crystalline masses imbedded in granite at Lindenaes in Norway, where it was first noticed by Mr. Tank of Friederickshall.

CARBONATE OF YTTRIA.

Berzelius' Jahres-Bericht, 1838, p. 207.

MM. Svanberg and Tenger have communicated to the Academy of Sciences in Sweden, an account of a new mineral found by them at Ytterby, and which proved to be Carbonate of Yttria. It occurs in very minute quantities in the cracks of the gadolinite, and occasionally also attached to another gangue in fragments scarcely large enough for convenient examination. Its color is white, and it presents an appearance of radiated crystallization. No further description of it has been given up to the date of *Rammelsberg's Handwörterbuch (Sup.)* 1843.

PYROCHLORE.*

Wöhler, (*Brewster's Journal*, vi. 358.) Microlite, *Shepard.* Rutilus dystomus, D.

Combination of columbic acid and lime essentially, with various metallic oxides.

	Fredeckswärn, Norway.
Titanic acid	62·75
Lime	12·85
Oxide of manganese	2·75
Oxide of iron	2·16
Oxide of uranium	5·18
Oxide of cerium	6·80
Oxide of tin	0·61
Water	4·20
	97·30 Wöhler.

	Miask, Siberia.	Brevig, Norway.
Columbic acid	67·376	67·021
Oxides of thorium and cerium	13·152	5·159
Lime	10·984	9·871
Yttria	0·808	4·601
Oxide of uranium	0·000	4·681
Protoxide of iron	1·285	1·329
Oxide of manganese	0·146	1·688
Sodium	3·930	trace
Fluorine	3·233	trace
Water	1·116	7·059
	102·030 Wöhler.	97·792 Wöhler.†

	Chesterfield, Mass.	Frederickswärn, Norway.
Columbic acid	75·70	53·10
Lime	14·84	19·45
Tungstic acid, yttria & protox. of uranium	7·42	0·00 0·00
Titanic acid	0·00	20·20
Peroxide of iron	0·00	2·35
Ox. of uranium, manganese and tin	0·00 0·00	1·20
Moisture	2·04	0·80
	100·00 Shepard.‡	97·10 Hayes.

	Chesterfield, Mass.
Columbic acid	79·60
Lime	10·87
Oxide of iron	0·99
Oxide of uranium and manganese	2·21
Oxide of lead	1·60
Oxide of tin	0·70
Moisture	0·40
	96·37 Hayes.

The results of these analyses show this mineral to be extremely complex in its chemical constitution, and point out a great variation in the proportion of the constituents which are supposed to be essential. It is essentially a columbate of lime. Berzelius § has given a formula answering to the second analysis by Wöhler, but the third differs from it in containing, besides oxide of uranium, a much greater quantity of water, as well as by the absence of fluoride of sodium, which he had regarded as an essential constituent of the mineral. For this he was unable to calculate a convenient formula adapted to the results obtained. The American mineral as now analyzed by Mr. Hayes, differs still more in the proportions of its acid and lime, and besides it contains oxide of lead. But it approaches very nearly to one atom columbic acid, and one atom lime — or Cal $\dot{C}l$ — which may ultimately prove to be the true composition of the purest crystals of this mineral. Sp. Gr. 4·25. H. = 5·0.‖

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[*] Named by Berzelius from its property of becoming yellowish-green, BB; from ϰυϱ, fire, and χλωϱος, green.

[†] The second specimen analyzed by Wöhler, gave traces of titanic acid, oxide of tin and magnesia; and the third gave in addition to these, uncertain traces of sodium and fluorine. The excess of weight in the second analysis is owing partly to the oxydation of the cerium which exists in the mineral as a protoxide. I have allowed the first analysis to remain as originally stated by Wöhler, though aware that the first product should be columbic acid *containing* titanic acid, as Wöhler himself afterwards ascertained, and as the analysis of the same mineral by Mr. Hayes has now confirmed. [Am. Ed.]

[‡] Amer. Jour. of Science, xxxii. p. 341.

[§] Rapport Annuel, 1840, p. 137.

[‖] Shepard gives the hardness of the Chesterfield variety at 5·25, and its specific gravity 5·562. Mr. Hayes makes the latter 5·405.

Color deep red-brown to black. The American specimens pale honey-yellow, or straw-yellow, and brick-red. Lustre resinous to vitreous. Translucent to opake, some crystals semi-transparent. Cleavage imperfect in the European specimens; more distinct in the American, parallel with the planes of the Regular octahedron, which is therefore the primary form. This form is also indicated by minute striæ on some of the American specimens. Fracture conchoidal. It occurs in the primary form either perfect, or modified on the edges by single planes, or on the solid angles by four planes resting on the faces of the crystals. B B, variety from Fredrickswän, yields water in the matrass, and becomes greenish-yellow; *per se*, on charcoal, it fuses with great difficulty into a blackish-brown scoria; with borax it effervesces and completely dissolves into a transparent globule, which appears reddish-yellow in the oxidating flame, but becomes opake on flaming, while in the reducing flame it is deep red, but changes into a bluish-grey enamel on flaming; with salt of phosphorus it entirely dissolves, the globule being yellow in the oxidating flame, and on cooling usually green; while in the reducing flame it darkens into violet; with soda gives the reaction of manganese. It gives also, as does the variety from Brevig, the reaction of uranium. The American specimens exhibit very nearly the same distinctive characters — differing slightly, as might be supposed, from the presence of different or lesser accidental bodies.

Pyrochlore was first discovered by Otto Von Tank, imbedded in syenite at Fredrickswän and Brevig in Norway. It has since been brought from Miask in Siberia, and from Greenland, but it is to be regarded as a very rare mineral.

In the United States it was first discovered by Prof. Shepard at Chesterfield, Mass., imbedded in the albite which contains the rubellite and green tourmaline, and was described by him as a new species under the name of microlite.* Its identity with pyrochlore was first indicated by Mr. Teschemacher, and has now been fully established by a very careful analysis, and a comparison of its pyrognostic characters, instituted by Mr. A. A. Hayes.

YTTROTANTALLITE.†

Yttrotantal, *Karsten*. Tantale Oxyée Yttrifère, H. Yttrotantalite, J. Columbus Berzelh, D.

Of the yttrotantalite, Berzelius has described three varieties, all differing considerably in composition. Dr. Thomson describes them as sub-species; the first as a tetracolumbate; the second as a discolumbate; and the third as a triscolumbate of yttria. But it seems to be an impure mineral, and never having been observed crystallized, Berzelius has regarded it as a mechanical mixture of tantalum, yttria, uranium, lime, and occasionally, of tungstic acid. They all consist essentially of columbate of yttria.

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* Amer. Jour. of Science, xxviii. p. 361. Mineralogy, ii. p. 46.

† From its consisting chiefly of yttria and tantalum; but its more appropriate name would now be yttro-columbite.

	Dark.	*Black.*	*Yellow.*	
Columbic acid	31·815	57·00	59·50	60·124
Yttria	38·515	20·25	24·90	29·780
Lime	3·260	6·25	3·29	0·500
Tungstic acid	2·592	8·25	1·25	1·044
Oxide of iron	0·555	3·50	2·75	1·155
Oxide of uranium	1·111	0·50	3·23	6·622
	97·848 Berzelius.	95·75 Berzelius.	99·89 Berzelius.	99·225

The dark yttrotantalite occurs in amorphous masses, has a lustre intermediate between vitreous and resinous, and when in thin fragments, appears translucent and slightly yellow. Specific gravity not exceeding 5·0.

The yellow yttrotantalite forms laminæ in the fissures of felspar. Its color is yellowish-brown, it has a white streak, and is opake. Specific gravity 5·8 to 5·9.

In the black variety, extremely indistinct traces of crystallization have been observed. It is black and opake, with an imperfect metallic lustre, and grey streak. Specific gravity 5·3 to 5·5.

None of these varieties are acted upon by acids, nor are fusible, *per se*, B B, although they decrepitate and acquire a lighter color; but they exhibit very different results when fused with re-agents.

They are all found in Sweden — at Ytterby, in red felspar; and at Broddbo and Finbo near Fahlun, imbedded in quartz and albite, and associated with garnet, mica, and pyrophysalite. They are among the numerous rare substances which have been brought to the notice of mineralogists, by the sagacity and careful researches of Berzelius.

FERGUSONITE.*

Haidinger, (*Edinb. Roy. Soc. Trans.*, x. part ii. p. 271.) Columbus hemiquadratus, D.

Combination of columbic acid, yttria, zirconia, and the oxides of cerium, tin, uranium, and iron.

---

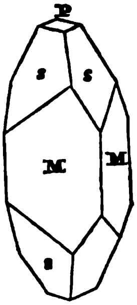
* In compliment to Robert Ferguson, Esq., of Raith, M. P.

Columbic acid	47·75
Yttria	41·91
Zirconia	3·03
Protoxide of cerium	4·68
Oxide of tin	1·00
Oxide of uranium	0·95
Peroxide of iron	0·34
	99·65 Hartwall.

The atoms of bases are about five times as numerous as those of the columbic acid, but it is probable that some of these constituents are only accidental. Formula, by Dr. Thomson, $4\frac{1}{2}\mathrm{Y}^5\dot{\mathrm{C}}\mathrm{l}+(\underline{\mathrm{C}}\mathrm{r}, \mathrm{Zr}, \mathrm{Ur}, \mathrm{F})^5\dot{\mathrm{C}}\mathrm{l}$.

Sp. Gr. 5·8 — 5·9. H. = 5·5 — 6·0.

In pyramidal crystals of a brownish-black color, which are opake except when in thin splinters, and are externally dull. Primary form a Right square prism, of which the following figure represents the actually occurring crystals.



s on *s* . . 100° 28′
s on *s*′ . . 128 27
z on *z*′ . . 159 02

Fracture perfect conchoidal, with a brilliant vitreous lustre; streak very pale brown; traces of cleavage parallel to the faces *s*. B B, *per se*, it is infusible, but loses its color and becomes pale greenish-yellow; is difficultly soluble with borax into a yellow glass; with soda is decomposed without melting, and leaves a reddish scoria. It may be entirely dissolved in salt of phosphorus, but some particles remain a long time unaltered. The pale-greenish globule becomes opake by flaming, or on cooling, when very much saturated. Previous to complete solution in the latter, the glass assumes in the reducing flame a slightly rose-red tinge.

This rare species was found by Sir Charles Gieśecké, disseminated in quartz, at Kikertaursak, near Cape Farewell, in Greenland. It was first distinguished as a new species, and described by Mr. Haidinger.

HAYESINE.[*]

Borocalcite.[†] Hydro-borate of Lime.

our accurate knowledge of this new mineral, we are in-l to A. A. Hayes, who ascertained that the pure speci-consisted wholly of borate of lime, united with water; e are indebted to him for the following description of its ters, as well as for determining its composition. Dried F., it contains in 100 parts:

Boracic acid	46·111	15·370	3
Lime	18·889	5·394	1
Water	35·000	31·111	6
	100·00		

ve regard the atomic weight of boracic acid as 3, the l evidently consists of three atoms boracic acid to one of lime; or it is a hydrated ter-borate of lime. Formu-al$\dot{B}^3+6Aq$. But taking Berzelius' atomic numbers, the a, as given by Mr. Hayes, is $\dot{C}a\dddot{B}^2+6\dot{H}$.

ccurs in globular masses of a fibrous structure, having ally a brown color; when broken these masses appear to med of snow-white delicate fibres, interwoven, curved notted; the lustre being satin-like, and the fibres so soft crush readily between the fingers. Placed in warm it expands, and forms a consistent paste, and exhibits ous tufts of radiating fibres. It dissolves in dilute ni-id, and the solution poured into a large quantity of am-

CLASS V.

ACIDIFEROUS ALKALINE MINERALS.

UNDER this head are included such minerals as consist chiefly of an alkali united with an acid; but several of them are very impure in their native state.

NITRATE OF POTASH.

Nitre, Naturlischer Salpeter, W. Potasse Nitratée, H. Prismatic Nitre, J. Prismatic Nitre Salt, M. Nitrum rhombicum, D.

Consists of potash 46·46, nitric acid 53·54; or one atom of potash, and one of acid. Formula: $K\dot{N}t$.

Sp. Gr. 1·9 — 2·0.

Primary form a Right rhombic prism of about 60° and 120°. Occurs in crusts, and in capillary crystals, of which the forms are not discernible; it is whitish or yellow; is translucent or transparent; brittle; saline, and cooling to the taste; it deflagrates when placed on a hot coal, and detonates with combustible substances.

It occurs on or near the surface of the earth, on old walls, &c. In Hungary, Persia, Arabia, Egypt, and in many of the plains of Spain, it is found in considerable quantities. It is also common in India, especially on a large plain near Agra in Bengal. The mountainous regions of Kentucky, which are calcareous and full of caverns, afford it to the inhabitants of North America. In South America, the plains bordering the sea, near Lima, are covered with it. It is not however produced naturally to an extent sufficient for its multiplied uses; and is therefore principally procured artificially from the decomposition of animal and vegetable substances.

Nitre is employed in medicine, the arts, and in metallurgy for assisting the processes of oxidating and smelting; but its pal, if not its chief use, is in the manufacture of gunpow- or which that imported from Egypt is most esteemed, as ains the least calcareous matter. Gunpowder consists of y-six parts of nitre, nine of sulphur, and fifteen of light oal. This salt has been found in several of the large which occur in the limestone in the Southern and West- ates, particularly in Madison county, Kentucky.

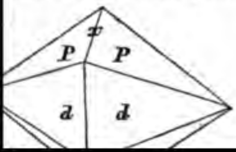
SULPHATE OF POTASH.

rismatoidal Glauber Salt, M. Aphthitalite, *Shep.* Potasse Sulphatée, H.

Sp. Gr. 1·731. H. = 2·5 — 3·0.

sive; mammillary, apparently formed in successive layers. white or yellow, with certain bluish or greenish stains. vitreous; translucent; taste saline and bitter; cleavage acture indistinct. Consists of sulphate of potash, with e of sulphate and muriate of copper.

artificial crystals present Right rhombic prisms, having acute angles replaced, so as to form dihedral summits; onsist of sulphuric acids 45·93, and potash 54·07; they pitate when heated, and fuse at an increased temperature.



edge *x* on that opposite	120°	29′
P on P	132	32
d on *d*	112	8

Formula by Beudant : $N\dot{C}^2+Aq$.

Sp. Gr. 1·5. H. = 1·0 — 1·5.

It is found crystallized, massive, fibrous, and sometimes radiated, in crusts, and efflorescent. Primary form, according to Haüy and Beudant, an octahedron with a rhombic base; but the form produced by dissolving and re-crystallizing artificially, is an Oblique rhombic prism ; P on M or M′ 108° 43′, M on M 76° 12′. When fresh, the massive is compact or granular, of a glistening lustre, and translucent, but on exposure it becomes opake. Color grey or yellowish-white ; taste urinous and saline. It effervesces with acids, is very soluble in water, and melts readily B B. It communicates a yellow tint to the flame of alcohol, by which it can be distinguished from carbonate of potash. It effloresces in the air.

The natural crystals of this species are rarely found distinct. Being a salt which loses its water on exposure to a dry atmosphere, it occurs most frequently in the state of efflorescent powder on the surface of the earth, at the sides of lake, or in natural caverns. In the plain of Debretzin in Hungary, it appears during the heat of summer in saline efflorescences like heaps of snow ; also in Bohemia, and Italy. It is likewise met with either dissolved in the water of certain hot springs, as those of Carlsbad in Bohemia and Rykum in Iceland, or in some lakes, as the soda lakes of Egypt. In South America, according to Mr. Blake, it is found near Pica in Peru, and at several places on the eastern border of that portion of the Desert of Atacama which lies in Bolivar.

The natron both of Egypt and Hungary is imported in pulverulent masses of a dirty-grey color. Its chief employment is in the manufacture of soap, but it enters also into the composition of glass, and is used in dyeing, bleaching, &c.

TRONA.

Urao, *Beudant.* Trona, *Haidinger.* (*Edinburgh Jour. of Science*, ii. 325.) Prismatic Natron, J. Hemi-prismatic Natron Salt, M. Natron permanens, D.

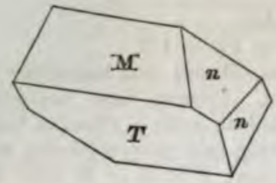
Combination of soda, carbonic acid, and water.

	Crystallized. Barbary.	*Fibrous.*	Columbia.
Soda	37·43	38·62	41·22
Carbonic acid	39·27	40·13	39·00
Water	23·28	21·24	18·80
Foreign matter	0·00	0·00	0·98
	99·98 Beudant.	99·99 Boussingault.	100·00 Rivero.

The above numbers correspond with the formula, $N\dot{C}^{1\frac{1}{2}}+2Aq$.

Sp. Gr. 2·112. H. = 2·5 — 2·75.

Primary an Oblique rhombic prism of 132° 30′ and 47° 30′.



n on *n*	132° 30′
M on T	103 15
n on T	103 45

Cleavage perfect and easily obtained parallel to M. Surface of *n* and M smooth, of T generally striated horizontally. Seldom in distinct crystals. Color white, inclining to yellowish-grey when impure. Transparent when in minute crystals, translucent in large masses; streak white; taste pungent and alkaline; fracture uneven; rather brittle. Soluble in water, though less so than natron. This substance is distinguished from the preceding not only in crystalline form, but in superior specific gravity and hardness; in being more difficultly soluble in water, and in its taste being less intensely alkaline; neither does it deliquesce as natron does, and it may be preserved for any length of time unchanged in a dry atmosphere.

It occurs in the province of Sukena in Egypt, forming a thin stratum in muriate of soda; also in Barbary, and in Maracaibo and Columbia in South America. *Trona* is its African, *Urao* its American name.

In the valleys of the Bolivian Andes, it was found by Mr. Blake in the waters of the small lakes, and encrusting the soil. At Payta, in the southern part of Peru, it forms beds of considerable extent, as also in the Province of Buenos Ayres at Caraeal, and resembles that from Africa. In Peru it is known by the Indian name of *Colpa*.

SULPHATE OF SODA.

Glauber Salt. Naturlisches Glaubersalz, W. Soude Sulphatée, H. Prismatic Glauber Salt, M. J. Exantholose, *Beudant.* Picralum Glauberium, D.

	Vesuvius.	Hildesheim.
Contains Soda	35·0	33·4
Sulphuric acid	44·8	42·5
Water	20·2	18·8
Earthy matter	0·0	5·3
	100·0 Beudant	100·0 Beudant.

Formula by Beudant: $N\dot{S}l^{3}+2Aq$.

Sp. Gr. 1·47.

Primary form an Oblique rhombic prism of 99° 36′ and 80° 24′.

Sulphate of soda is found in efflorescences of a yellow or greyish-white color, or in an earthy form, but is more commonly dissolved in certain mineral waters; translucent or opake; lustre vitreous on the fresh fracture, dull on the surface; extremely efflorescent, and falling spontaneously into powder. It is cooling, bitter and saline to the taste, and is usually met with in the neighborhood of rock-salt or brine springs. B B, in the matrass it melts in its water of composition.

Sulphate of soda is found in the salt mines of Upper Austria, Hungary, and Switzerland; near Madrid in efflorescences at the bottom of a ravine; at Grenoble in France; in the workings of old mines, and sometimes on old walls, in the same manner as nitre. It is an ingredient of the hot springs of Carlsbad, Eger, and Sedlitz in Bohemia. Mixed with common salt, sand, and gypsum, sulphate of soda forms a considerable part of the desert of Atacama in the western part of Bolivar; and in the northern part of Peru, with nitrate of soda and common salt, it forms beds several feet in thickness, which cover a surface of several hundred square miles.—*Blake.* When purified of the iron with which it is usually tinged in the native state, or when prepared artificially, it is used in medicine under the name of *Glauber's Salt.*

THENARDITE.

Necker. Picralum Thenardianum, D.

Anhydrous sulphate of soda, mixed with a minute proportion of the sub-carbonate of soda. Sulphate of soda 99·78, sub-carbonate of soda 0·22.—*Casaseca.* Specific gravity 2·73. Primary form a Right rhombic prism of about 125° and 55°. Occurs in rhombic octahedrons, simple, or modified on the summit, which are grouped one upon another. Cleavage parallel to the faces of the prism; most distinct parallel to its base. Color white or reddish; transparent or translucent. Superficially efflorescent. B B, in the matrass, yields no water. Soluble in water. This substance occurs in crystalline coatings at the bottom of certain lakes, at a place called Les Salines Espartines, five leagues from Madrid, and two and a half from Aranjuez; where it is collected for the fabrication of artificial sub-carbonate of soda. This mineral has also been discovered by Mr. Blake in Peru, near Tarapaca, and in Bolivar, forming veins in the sandstone and gypsum, and often crystallized in small rhombic prisms.

NITRATE OF SODA.

Zootinsalz, *Breithaupt.* Soude Nitratée, *Necker.* Nitrum rhombohedron, D.

It usually occurs mixed with other salts, as shown by the analyses of the specimens from Peru, as given on the next page.

Consists of Soda	45·03	37·2
Nitric acid	54·97	62·8
	100·00	100·0 Gmelin.

The last analysis gives almost exactly one atom acid and one atom borax. Formula: $N\dot{N}t$.

Sp. Gr. 2·1. H. = 1·5 — 2·0.

Primary form an Obtuse rhomboid of about 106° and 74°; cleavage parallel to the faces of the primary. This salt appears occasionally as an efflorescence, sometimes crystallized, more often intermixed with clay and sand; to the taste it is cool and bitter; it is deliquescent; and when exposed on heated charcoal it melts and deflagrates. It is described by Mr. Blake as occurring in extensive beds resting on marl containing fragments of shells, on the western border of the Pampa of Tamerugal, province of Tarapaca, in Peru. The average depth of the beds is four feet. The mass is not a pure nitrate of soda, but consists of variable proportions of sulphate of soda and common salt, with *iodate of soda* and *chloro-iodate of soda*, as appears by the analyses of Messrs. Hayes and Blake. The mixed salt is termed *caliche*. It possesses a granular structure, some specimens resembling pure refined sugar, while others are reddish-brown, common yellow, and grey. These mixed salts gave the following results:

	Peru.	Peru.	Peru.		Peru.
Nitrate of soda	64·98	64·00	70·20		94·291
Sulphate of soda	3·00	2·25	5·65	Sulphate of potash	0·239
Sulphate of magnesia	0·00	2·75	0·00	Nitrate of potash	0·426
Chloride of sodium	28·69	29·30	20 70		1·990
Iodic salts	0·63	0·00	2·20	Nitrate of magnesia	0·858
Shells and Marl	2·60	0·50	1·05	Water	1·993
				Sand	0·203
	99·90*	98·80†	99·80‡		100·000§

In 1837, 150,000 quintals of refined nitrate of soda were shipped from the port of Yquique.

Large cavities in the beds are often met with which contain large and regular crystals of nearly pure nitrate of soda.

BORATE OF SODA.

Boraxsaures Natron, L. Soude Doratée, H. Prismatic Borax Salt, M. Biborate of Soda. Borax. Tincal. Borax obliquus, D.

Contains, by Klaproth's analysis, soda 14·5, boracic acid 37·0, water 47·0. Formula: $N\dot{B}^2$.

Sp. Gr. 1·74. H. = 2·0 — 2·5.

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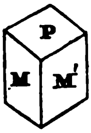
[*] By Mr. Hayes, average specimen taken from numerous beds.—Amer. Jour. of Science, xxxix. p. 378.

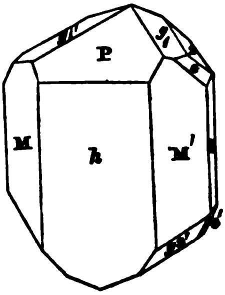
[†] By Mr. Blake, portion of a white compact mass from Almonte.

[‡] Also by Mr. Blake. Specimen of a brown yellow color from Molina.

[§] Analysis by Horstetter.—Rammelsberg's Handwörterbuch.—Supplement, p. 103.

Tincal occurs in prismatic crystals, variously terminated, and yielding to mechanical division parallel to the lateral planes of the primary form—an Oblique rhombic prism of 86° 30′ and 93° 30′—and both its diagonals. The crystals are whitish, occasionally possess a tinge of blue or green, and vary from translucent or nearly transparent, to opake. Taste feebly alkaline; soft and brittle. B B, it intumesces violently and then fuses into a transparent globule.





M on M	86°	30′
P on M or M′	101	30
M or M′ on h	133	20
M′ on k	136	45
— — e	133	12
P on h	106	30
— — g1	139	15
— — g2	115	30
— — e	114	28
e on g2	141	52

Tincal is chiefly brought from Thibet, where it is found on the surface of the soil in the vicinity and at the bottom of certain lakes. It is mentioned likewise from the province of Potosi in Peru. The borax in its crude state is called *tincal*, and is brought to Europe in the form of a brownish-grey impure salt, or in detached crystals resembling the above figure.

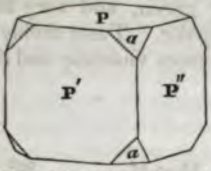
It is employed as a flux in several metallurgical processes, and in the manufacture of solder.

CHLORIDE OF SODIUM.

Hexahedral Rock Salt, M. J. Steinsalz, *Leonhard*. Sal Mare, *Beudant*. Sel Gemme, *Necker*. Chloride of Sodium. Sal cubicum, D.

Rock-salt is anhydrous, or contains no water of crystallization, and when pure, consists of chlorine 59·5, and sodium 40·5, or one atom of each element. It was formerly regarded as a compound of muriatic acid and soda. The Cheshire rock-salt contains, by Henry's analyses, nearly two parts of impurities; viz. sulphate of lime, chloride of calcium, and chloride of magnesium. Sp. Gr. 2·3. H. = 2·0. It occurs in beds or masses; sometimes crystallized in the form of the cube, which is that of its primary crystal, and into which, when pure, it may readily be cleaved; lustre vitreous; translucent or transparent; when pure, colorless or white; but when with any foreign admixture, reddish-brown, brick-red, violet-blue, and green.

It yields with facility to the knife; and when scratched with the nail receives an impression, but yields no powder. It attracts moisture, but remains unaltered in a dry atmosphere. It has sometimes, though rarely, a fibrous texture.



P on P′ or P″	90°	00′ H.
P, P′, or P″, on *a*	125	15 —
a on *a*	109	28 —

Chloride of sodium is one of the most abundant substances in nature. Not only is it found in large beds and masses, but also in the waters of certain springs and lakes, and in those of every sea. It forms about one-thirtieth part of the waters of the ocean.

Rock-salt is commonly disposed in thick beds, either superficially, as in Africa, or at a very great depth, as in Poland; sometimes also at a high level, as in the Cordilleras of America, and in Savoy, where it occurs at an elevation equal to that of perpetual snow.

Its principal European deposits are the salt-mines of Wieliczka in Poland, where perfect cubes are frequently met with; the Saltzkammergut in Upper Austria, Hallein in Saltzburg, and Hall in the Tyrol, in which it is accompanied with, and imbedded in clay, gypsum, and other extraneous matter; and Northwich in Cheshire, where it occasionally presents pure, transparent, and highly cleavable specimens. All these deposits afford extensive supplies for culinary and other economic purposes, though generally in a state so far from pure as to render the process of solution and subsequent evaporation indispensable.

In Peru, Bolivar and Chili, this salt often appears in thin crusts on the surface mixed with other salts, and also in extensive beds. On the Pampa of Tamarugal in the southern part of Peru, round masses of rock-salt, five or six feet in diameter, lie piled one above another to the depth of several feet, presenting a rough, white and dazzling surface extending for several leagues. They are used by the inhabitants in constructing their houses. In some places it is of a deep red colour, but in the vicinity of Pisco it is sufficiently pure for the ordinary purposes to which it is applied. Fine crystallized specimens, remarkable for transparency, were found in the Bolivian Andes. —*Blake*. According to Dana very beautiful crystals of cubic salt are found at the Ewa Salt Lake, Oahu. In the United

States the numerous salt springs are supposed to have their origin from the solution of rock-salt, but we have had no well authenticated account of its occurrence in any other form until very recently. In the *American Journal of Science*, vol. xli, the Editors have announced the discovery of this valuable substance in Washington county, Virginia, where it is found in the midst of salt springs, and is accompanied by gypsum. "It is highly crystalline in its structure, and excepting its red colour, derived from iron, and occasionally fragments of rock mixed with it, appears to be very pure. Some of the specimens are perfectly white." In the Journal of the Exploring Tour of the Rev. Samuel Parker beyond the Rocky Mountains, we are assured of its occurrence in the saliferous sandstone bordering on Salmon River, and in the vicinity of the Great Salt Lake, whose waters are so strongly saturated that crystals form upon the shore.*

NATIVE DECREPITATING ROCK-SALT.† It is well known that ordinary rock-salt does not decrepitate by exposure to heat, which seems to indicate that it was not deposited from an aqueous solution, because all the marine salt obtained in this way possesses the property of decrepitating. There exists however in the mines of Wieliczka, a rock-salt which decrepitates, and which has been examined by Dumas, H. Rose, and by Berzelius, and proved to contain cavities filled with compressed gases. When the salt is dissolved in water, as the covering over these vesicles become thinner and thinner, they at last burst, and the gasses escape with violence. This fact was first observed by M. Dumas. M. Rose ascertained that the quantity of these gases disengaged, varied in different specimens, and on analysis, he found in 100 volumes, 24 volumes of pure hydrogen, 17 of carbonic acid gas, and 59 of carburetted hydrogen. Berzelius supposes that it contains besides, carbonic acid which remains dissolved in the water. This salt is not described as differing in any other respect from common mineral salt. M. Rose is inclined to refer the decrepitation of several other minerals to the same cause.

SULPHATE OF AMMONIA.

Mascagnin, *Kersten*. Ammoniaque Sulphatée, H. Picralum volcanicum, D.

Contains ammonia 22·80, sulphuric acid 53·29, water 23·91. —*Gmelin*. Chemical formula by Berzelius, $\dot{N}H^6+\dddot{S}+2Aq$.

Sulphate of ammonia has an acrid, bitter taste. Its color is greyish or yellow, and it generally occurs stalactitic, pulverulent, or in mealy efflorescences; translucent or opake; attracts moisture from the atmosphere, and is entirely volatile at a high temperature. It is found in the fissures of the earth, and among the lavas of Etna and Vesuvius; in the Solfatara; and in the *lagune* near Sienna in Tuscany.

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* Journal, second edition, p. 114.

† Berzelius' Rapport Annuel, 1840, p. 139.

MURIATE OF AMMONIA.

Sal Ammoniac. Naturlicher Salmiak, W. Ammoniaque Muriatée, H. Octahedral Ammoniac Salt, M. J. Picralum octahedrum, D.

When pure, it consists of ammonia 32·06, muriatic acid 51·16, water 16·78; or by the Formula as given by Berzelius, $\dot{N}H^6\dot{M}^2+Aq$. Two varieties yielded to Klaproth,

	Vesuvius.	Bucharia.
Muriate of ammonia	99·5	97·5
Sulphate of ammonia	0·5	2·5
	100·0	100·0

Sp. Gr. 1·45 to 1·5. H. = 1·5 — 2·0.

Primary form the Regular octahedron. It occurs massive; with a fibrous texture; plumose; in crusts; and in octahedral crystals of a minute size. Color, when pure, white, grey, or yellow; generally pungent and saline to the taste; transparent or opake; externally dull or glistening; internally shining and vitreous. This salt is readily soluble in water, but does not attract moisture on exposure to the air. It is completely volatile at a high temperature, rising in white fumes; and emits, when triturated with lime, a pungent ammoniacal odor.

It is principally found in the neighborhood of volcanoes, sublimed among other volatile substances, in the cracks and fissures of lava. It thus occurs at Etna and Vesuvius, in the island of Volcano, and at the Solfatara near Naples. Small quantities have been noticed in the vicinity of ignited coal seams, as at St. Etienne in France, in Scotland, and Newcastle. A variety presenting a greyish-white color, and conchoidal fracture, is mentioned as occurring with sulphur, in rocks of indurated clay or clay-slate in Bucharia. Though extensively employed in dyeing and in medicine, this salt is of trifling importance as found in nature, from its scarcity.

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CLASS VI.

ACIDIFEROUS ALKALINO-EARTHY MINERALS.

THE mineral substances included under this head are few in number.

POTASH-ALUM.

Naturlischer Alaun, W. Alumine Sulfatée Alkaline, H. Octahedral Alum, J. Octahedral Alum Salt, M. Alaun, L. Alumen officinale, D.

Combination of sulphate of alumina, sulphate of potash, and water; and contains alumina 10·82, potash 9·94, sulphuric acid 33·77, water 45·47—*Gmelin*. Formula: $3Al\dot{S}l+K\dot{S}l+25Aq$.

Sp. Gr. 1·75. H. = 1·5.

Primary form the octahedron, though it chiefly occurs in fibrous masses, or as an efflorescence on argillaceous minerals, as alum-slate, alum-stone, &c. Color white or greyish; lustre vitreous, transparent or translucent; to the taste sweetish, styptic, and acidulous. When artificially prepared, it crystallizes in the octahedron, and in some of its varieties. It is soluble in about twenty times its weight of cold, and little more than its own weight of boiling water. On exposure to heat it melts in its water of crystallization, froths up in a remarkable manner, and is converted into a spongiform mass of anhydrous alum.

It is found on the alum-slate rocks near Christiana in Norway: in strata of brown coal in Bohemia; on the lavas of Stromboli, Nevis, and other volcanoes; in bituminous shale and slate-clay at Hurlet near Paisley; and near Whitby in Yorkshire.

Alum in white nearly pulverulent masses, and also crystallized sometimes with sulphur, occurs at Lua Pele, Hawaii. In the United States it has numerous localities as efflorescences, on the surfaces of rocks.

It is used in dyeing, in medicine, in the manufacture of paper and leather, and for the prevention of putrefaction.

ALUM-STONE.

Alunite, *Necker.* **Alaunstein, W. Rhombohedral Alum Haloide, M. Rhomboidal Alumstone, J. Aluminus rhombohedrus, D.**

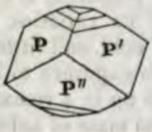
Combination of sulphuric acid, alumina, potash, and water.

	Crystallized, Tolfa.	Montione.
Sulphuric acid	35·49	35·6
Alumina	39·65	40·0
Potash	10·00	13·8
Water	14·83	10·6
	99·97 Cordier.	100·0 Descotils.

Formula as stated by Dr. Thomson from the first analysis: $3Al^3\dot{S}l+K\dot{S}l+8Aq$.

Sp. Gr. 2·7 — 2·75. H. = 5·0.

The color of this mineral is usually greyish-white, occasionally red; and it occurs both massive and crystallized, the crystals generally occupying the cavities of the mass; they are minute, shining, and sometimes brownish externally; their form is an Obtuse rhomboid of 92° 50′ and 87° 10′; but the rhomboid is variously modified, one or more of the solid angles being generally replaced. Cleavage distinct perpendicular to the axis. The massive is translucent and easily frangible, being frequently mixed mechanically with silica, and appearing cellular and porous. It decrepitates under the blowpipe, but does not fuse *per se.* With borax it forms a transparent colorless globule, but is not affected by soda; when pounded it is soluble in sulphuric acid.



P on P′	92° 50′
P or P′ on P″	87 10

It occurs well crystallized in a secondary rock at Tolfa, near Civita Vecchia, in the Roman States; decomposed and friable at the Isle of Nevis, and in the crater of Volcano; and so compact and hard at Beregh in Hungary, as to be there employed in the formation of millstones.

POLYHALLITE.*

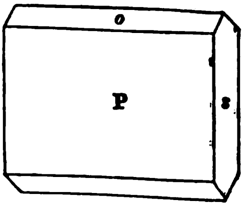
Stromeyer, **(*Untersuchungen*, i. 144.)** **Bloedite, *John.*** **Gealum columnare, D.**

Sulphate of lime	**44·74**
Sulphate of magnesia	**20·03**
Sulphate of potash	**27·70**
Chloride of sodium	**0·19**
Oxide of iron	**0·33**
Water	**5·95**
	98·44 Stromeyer.

Formula: $2\mathrm{Cal}\dot{\mathrm{S}}\mathrm{l}+\mathrm{Mg}\dot{\mathrm{S}}\mathrm{l}+\mathrm{K}\dot{\mathrm{S}}\mathrm{l}+2\mathrm{Aq}$.

Sp. Gr. 2·77. H. = 2·5 — 3·0.

In masses, which are either compact, or present a fibrous texture, the fibres being parallel and mostly curved. Of a brick- or flesh-red color, and somewhat translucent; brittle; has a resinous or pearly lustre; taste bitter and astringent, but very faint. It is slightly acted upon by exposure to a moist atmosphere, but its solubility in water is very inconsiderable. In the flame of a candle it immediately forms an opake brownish-colored mass; and melts instantaneously under the blowpipe.



The adjacent faces *o* to *o* about . . . . . . **115°**

It is found at Ischel and Aussee, in Upper Austria, in beds of rock-salt, and at Hall in the Tyrol. The mineral noticed by Leonhard under the name of *Bloedit* (after the Dresden mineralogist Bloede) as occurring at Ischel with the polyhallite, and described as being soft, of a close fibrous texture, of a color between flesh- and brick-red, as transparent and brilliant, but losing both these characters by exposure, — is probably only an impure variety of this species.—*Allan's Manual.*

CRYOLITE.†

Kryolith, W. Alumine Fluatée Alkaline, H. Prismatic Cryone Haloide, M. Prismatic Crydlite, J. Soda Fluate of Alumina. Cryalus fusilis, D.

Combination of fluoric acid, soda, and alumina.

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[*] **From the Greek πολας, αλς, signifying a stone of many salts; in allusion to its composition.**

[†] **Cryolite, from the Greek, in allusion to its fusibility, — to its melting, B B, like ice.**

Alumina	24·0	24·40
Soda	36·0	31·35
Fluoric acid	40·0	44·25
	100·00 Vauquelin.	100·00 Berzelius.

Composition, as given by Beudant, conforming to the chemical formula of Berzelius: $2Al\dot{F}l^3+3N\dot{F}l^2$.

Sp. Gr. 2·96. H. = 2·5 — 3·0.

It occurs massive; white, but, when associated with iron, yellow or brown; structure perfectly lamellar, parallel to all the planes of a Right rectangular prism; translucent, but by immersion in water it becomes transparent, and admits more readily of cleavage when retained in that fluid for some time. It is very fusible, dissolving even in the flame of a taper. B B, on charcoal, it melts into a transparent globule while hot, but which becomes opake on cooling.

The only known locality of this mineral is Arksut-fiord in West Greenland, where it occurs in veins in gneiss, accompanied with carbonate of iron, pyrites, galena, quartz, and felspar.

GLAUBERITE.*

Glauberite, Bt. H. J. Hemi-Prismatic Brythine Salt, M. Brogniartin, L. Gæalum obliquum, D.

Combination of sulphuric acid, lime, and soda, without water.

	Villa Rubia.
Sulphate of lime	49·0
Sulphate of soda	51·0
	100·0 Brogniart

Formula: $Cal\dot{S}l+N\dot{S}l$.

Sp. Gr. 2·75 — 2·85. H. = 2·5 — 3·0.

It occurs massive; also crystallized in the form of oblique and extremely flat rhombic prisms, the crystals being for the most part constituted only of the planes P, *e*, and *e′* of the following figure; but they yield readily to mechanical division, parallel to the faces P, M, and M′, the primary form being an Oblique rhombic prism, whose terminal planes incline from one acute edge of the prism to the other, and whose lateral angles are alternately 83° 20′ and 96° 40′. Color pale yellow or grey; translucent, rarely transparent; taste slightly saline; lustre vitreous; fracture conchoidal: when immersed in water, it becomes opake and is partly soluble. B B, it decrepitates, and then melts into a white enamel.

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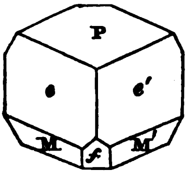
* From its containing a very large proportion of Glauber's salt, or sulphate of soda.



M on M′	83°	20′
P on M or M′.	104	15
—— e or e′	137	09
——f	112	20
M or M′ on f	131	35
M on e or M′ on e′	147	40
e on e′	116	20
e or e′ on f	132	37

It is found at Villa Rubia, ten leagues south of Madrid, in Spain, imbedded in rock-salt; also at Aussee in Upper Austria. It has recently been found by Mr. Blake in the desert of Atacam in South America, in minute rhombic prisms, associated with chloride of sodium. Its optical properties, according to Sir David Brewster, are very peculiar—having one axis of double refraction for violet, and two axes for red light.

REUSSITE.

Soda Sulphate of Magnesia. *Thomson.*

Sulphate of soda 66·04, sulphate of magnesia 31·35, muriate of magnesia 2·19, sulphate of lime 0·42—Reuss.

Occurs in mealy efflorescences, flat six-sided prisms, and acicular crystals. Color white, shining; fracture conchoidal. Taste saline and bitter; soluble in water.

This substance forms superficial efflorescences in the vicinity of Sedlitz and Seidschutz in Bohemia.

SODA-ALUM.

Thomson. (*Outlines, &c.*, p. 306.)

Contains, by Dr. Thomson's analyses, sulphuric acid 38·5, alumina 12·0, soda 7·5, water 42·0, with a little silica, lime, iron, and manganese. Formula: $3Al\dot{S}l+N\dot{S}l+20Aq$.

Sp. Gr. 1·88. H. about 3·0.

Occurs in white fibrous masses, the outer fibres opake from decomposition, internally transparent, and exhibiting a glossy or silky aspect. Resembles alum in taste, but is more soluble in water. Exposed to heat it exhibits the same phenomena as common alum. It bears some resemblance to fibrous gypsum, but is harder, not being scratched by the nail.

Is found in irregular nodules resembling fibrous gypsum, imbedded in soft blue slate, at St. Juan in South America; and Beudant mentions it as also occurring in the solfataras of Milo in the Archipelago.

GAYLUSSITE.*

Cordier. Boussingault. (*Ann. de Chim. et de Phys.* xxxi. 270.)

Combination of carbonic acid, soda, lime, and water.

Carbonate of soda	33·96
Carbonate of lime	31·39
Water	32·20
Alumina	1·00
Carbonic acid	1·45
	100·00†

These products divided by the atomic weights, give one atom carbonate of soda, one atom carbonate of lime, six atoms water. Formula: $Cal\dot{C}+CalN+6Aq$.

Sp. Gr. 1·92—1·95. H. 2·0—3·0.

Occurs in detached lengthened prisms, and aggregated crystals disseminated in clay; the less perfect of them might be mistaken for selenite, the more perfect and smooth have rather the aspect of calcareous spar. Primary, an Oblique rhombic prism of 109° 30′ and 70° 30′, according to Beudant; of 111° 10′ and 68° 50′, according to Leonhard. Surfaces striated; limpid and colorless, or of a dirty white; transparent, with marked double refraction; or translucent; fracture conchoidal, with a vitreous lustre; very brittle; easily reduced to a grey powder, and soluble with brisk effervescence in nitric acid. When reduced to powder, is, to a trifling extent, soluble in water. In the matrass it decrepitates slightly, gives off water, and becomes opake, decrepitation continuing until it has acquired a red heat. B B, it fuses rapidly into an opake globule, which has a distinctly alkaline taste.

This mineral is found abundantly at Lagunilla near Merida, in Maracaibo, disseminated at the bottom of a lake in a bed of clay, covering trona, which the natives term *urao,* in contradistinction to the gaylussite, the latter, from its generally elongated form, being denominated *clavos* or nails.—*Allan's Manual.*

NATIVE CARBONATE OF LIME AND SODA.

Barruel. (*Ann. of Phil. May,* 1830.)

Contains	Carbonate of lime	70·0
	Carbonate of soda	14·0
	Water	9·7
	Peroxide of iron	1·0
	Matrix	5·0
		99·7

Sp. Gr. 2·92. H. = 3·0—3·5.

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* In honor of the celebrated French chemist Gay-Lussac.

† For another analyses of Gaylussite, see Ann. de Chi et de Phys. Avril, 1843.

Primary form a rhomb, not differing materially from that of calc-spar. Cleavage in three directions parallel to the faces of the primary. Lustre vitreous; structure laminated; fragments perfectly transparent; possesses double refraction. B B, it decrepitates a little, becomes brown, and eventually is reduced to lime. Entirely soluble, and with effervescence, in nitric acid.

Locality unknown.

AMMONIA-ALUM.

Ammonalum, *Necker* and *Beudant.*

Contains, by the analyses of Gruner, sulphuric acid 33·682, alumina 10·750, ammonia 3·619, water 51·000. Another specimen from Selenginsh, in the government of Irkutsk, analyzed by M. Komonen,* sulphuric acid 30·335, lime 4·793, alumina 7·451, oxide of iron 1·114, ammonia 2·893, water and insoluble matter 53·414.

Consists principally of sulphate of alumina and ammonia, but the proportions vary considerably in the specimens that have been analyzed.

Sp. Gr. 1·56. H. = 1·2.

Lustre resinous and shining; structure fibrous; cross fracture conchoidal; translucent to transparent; has the appearance of alum, is soluble in water. Its color is greyish-white. It occurs in fibrous masses, but by solution and evaporation yields regular octahedral crystals.

White; taste bitter. B B, in the matrass it yields water, intumesces, and forms a sublimation of the sulphate of ammonia, which is soluble in water. The dried mass becomes blue with solution of cobalt.

Occurs in the lignite of Tschermig in Bohemia.

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* Trans. Imp. Min. Society of St. Petersburg, 1842, p. 58.

CLASS VII.

NATIVE METALS AND METALLIFEROUS MINERALS.

This class includes such metals as are found nearly pure in the native state; or variously combined with other substances, forming metalliferous ores; as, with other metals, with sulphur, with oxygen; also in the state of oxides, mineralized by acids. We begin with the oldest and most universally diffused of the metals — iron.

NATIVE IRON.

Gediegen Eisen, W. Fer Natif, H. Octahedral Iron, M. Ferrum octahedrum, D.

	Agram.	Siberia.	Mexico.	Atacama.
Iron	96·5	98·5	96·75	93·40
Nickel	3·5	1·5	3·25	6·62
Cobalt	0·0	0·0	0·00	0·53
	100·0 Klaproth.	100·0	100·00	100·55 Turner.

	Meteoric. Coke County, Tenn.	*Meteoric.* Red River.
Iron	93·80	90·02
Nickel	4·66	9·67
Silica, Carbon and Phosphorus	0·10	0·00
Oxygen, Sulphur, &c.	1·44	0·00
	100·00 Shepard.	99·69 Shepard.

	Meteoric. Claidborne.		*Meteoric.* Coke County, Tenn.
Iron	66·560		87·0
Nickel	24·708		12·0
Chrome and Manganese	3·240	Carbon	0·5
Sulphur	4·000		0·5
Chlorine	1·480		0·0
	100·008 Jackson.		100·0 Troost.

In these specimens, while the iron seems to maintain nearly the same per centage, the nickel and all the other constituents are very inconstant in their proportions.

Cramer describes a mass found in the mines of Hackenburgh weighing four pounds. In the United States, there are two or three well authenticated instances of the occurrence of native iron, of terrestrial origin; at Canaan, Conn., where it formed a vein about two inches thick, attached to a mass of mica-slate; and in Guilford county, N. C., where a mass of twenty-eight pounds weight was obtained, from which an octahedral crystal weighing seven ounces was detached. This crystal is now in the Yale College cabinet.

Sp. Gr. 7·44—7·8. H. = 4·5.

Primary form the Regular octahedron. Color pale steel-grey; lustre metallic; acts powerfully on the magnet; is soluble in all the acids.

Native iron has been noticed under three different forms.

1. At Kamsdorf in Saxony, disseminated through a mass of brown oxide of iron mingled with spathose iron and sulphate of barytes; in this Klaproth found about 6 per cent. of lead, and 1·5 of copper. It is not however considered a natural production; but, like the native steel from La Bouiche in France, appears to be of secondary formation.

2. Native volcanic iron. Fer natif volcanique, H. Was discovered in a ravine formed by torrents across the lava and scoriæ of the mountain of Graveneire, in Auvergne.

3. Native meteoric iron. Fer natif meteorique, H. This occurs in irregular isolated masses, sometimes of very considerable size, in different parts of the globe: but the only piece described as having been seen to fall from the atmosphere is that of Hraschina, near Agram in Croatia. The mass found in Siberia, by Professor Pallas, exhibited a vesicular structure, and contained crystals and grains of chrysolite; that discovered by Don Rubin de Celis, in the district of Chaco-Gualamba in South America, weighed about fifteen tons. Specimens also occur in Africa, as in the Senegal river, and near the Cape of Good Hope. The mass lately noticed in the Atacama desert of Peru, has a vesicular appearance, and contains straw-yellow colored olivine.

The Pallas meteoric iron is a mass weighing twelve hundred and seventy Russian pounds. It is now in the Imperial Cabinet.

In the United States, an extraordinary mass of meteoric iron was discovered many years since on the Red River, Louisiana. It was removed at great expense, and was purchased by the late Col. George Gibbs, by the liberality of whose family it has passed into the cabinet of Yale College. Its weight is upwards of sixteen hundred pounds. A portion of it presents sections of octahedral crystals. In 1833, a mass of native iron was dis-

ed at Claiborne, Ala., which has been regarded with great
est, inasmuch as its analysis by Dr. C. T. Jackson, first
the discovery of chlorine as a constituent of meteorites
ined with the iron and nickel.* Since this discovery,
ine has also been detected in several other meteorites.
e original weight of the mass of meteoric iron found in
county, Tenn., of which we have given the analysis by
'roost and Prof. Shepard, was about two thousand pounds.
fers in its mechanical combination from any meteoric
as it contains fragments of carbonate of iron, sulphuret
n and hydrous oxide of iron.†

CUBIC IRON PYRITES.‡

YELLOW IRON PYRITES.

lkies, W. Fer Sulphuré, H. Bt. Hexahedral Iron Pyrites, M. J. Pyrite Mar-
Br. Mundic. Marcesite. Eisenkies, L. Bisulphuret of Iron, *Thomson.* Py-
ubicus, D.

lphuret of iron, like carbonate of lime, occurs under
ncompatible crystalline forms, each presenting the same
c constitution, as determined by accurate chemical anal-
It therefore belongs to the class of dimorphous sub-
es. The two species were supposed to be chemically
ct, until their composition was shown to be identical by
lius. It is a combination of iron and sulphur in the fol-
g proportions.

Iron	47·85	46·08
Sulphur	52·15	53·92

capillary, and crystallized in the Cube and octahedron, and in forms common to them both as primary crystals. But the cube is usually considered to be the primary form. It yields to cleavage parallel to all the planes of the cube and regular octahedron, affording surfaces sufficiently brilliant for the use of the reflective goniometer, but with the greatest ease and brilliancy parallel to those of the cube; its fracture is granular or uneven, sometimes approaching to conchoidal; it is brittle, but does not yield to the knife, which serves at once to distinguish it from copper pyrites, which it readily scratches. In the flame of a candle it becomes red; the sulphur being driven off, and an oxide of iron, which is magnetic, remaining. After a lengthened exposure to the reducing flame of the blowpipe, it forms an uneven and crystalline black mass.

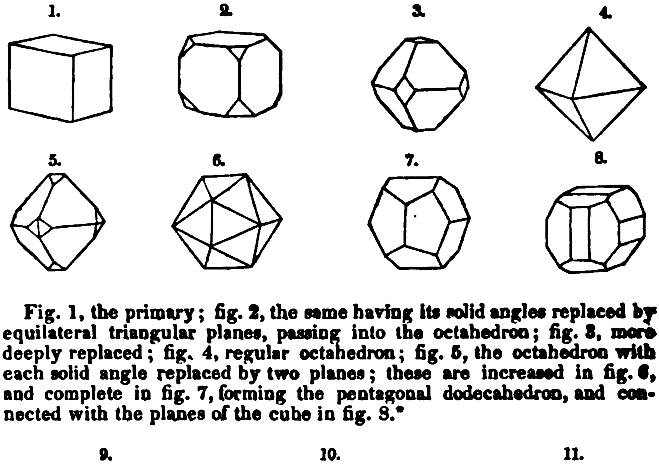
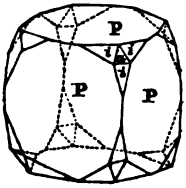
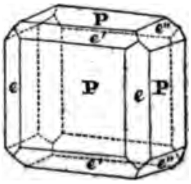


Fig. 1, the primary; fig. 2, the same having its solid angles replaced by equilateral triangular planes, passing into the octahedron; fig. 3, more deeply replaced; fig. 4, regular octahedron; fig. 5, the octahedron with each solid angle replaced by two planes; these are increased in fig. 6, and complete in fig. 7, forming the pentagonal dodecahedron, and connected with the planes of the cube in fig. 8.*

9.



10.



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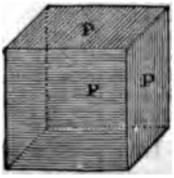

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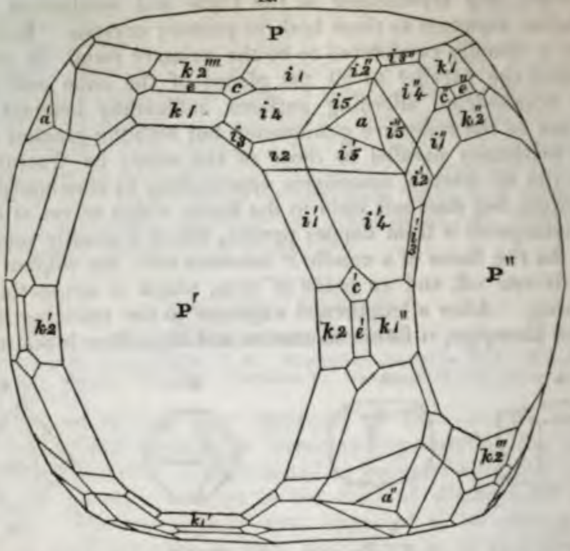
* For numerous modifications of this species, the student is referred to Haüy, (Traité, seconde edi. tom. iv. p. 38), and particularly to Levy's "Description d'une collection de Minéraux, formée par Henri Houland," tom. iii. p. 127, in which he has given the locality of each specimen, and described the various other crystallized substances that happen to be associated with it. [Am. Ed.]

12.



The above figure and the following measurements are given on the authority of Haüy.

P on P′ or P″	90°	00′	00″
P P′ or P″ on *a*, P or P′ on *a*′, or P′ or P″ on *a*″	125	15	52
P or P′ on *e*, P′ or P″ on *e*′ or P or P″ on *e*″	135	00	00
P on *i*1, P′ on *i*1′, or P″ on *i*1″	150	47	40
P on *i*4, P′ on *i*4′, or P″ on *i*4″	143	18	03
P on *k*1′, P′ on *k*1′, or P″ on *k*1″	146	18	38
P′ on *k*2 or *k*2′, P″ on *k*2″ or *k*2‴, or P on *k*2⁗	153	26	5
a on *a*′ or *a*″	109	28	16
a on *e*, *e*′, or *e*″	144	44	8
——— *i*5, *i*5′, or *i*5″	157	47	33
——— *i*3, *i*3′, or *i*3″	164	12	24
——— *k*2, *k*2′, or *k*2″	140	46	7
*i*5 on *i*5′, *i*5′ on *i*5″, *i*5″ on *i*5‴	146	26	33
*i*4 on *i*4′, *i*4′ on *i*4″, *i*4″ on *i*4	141	47	12
*i*4 on *i*1, *i*4′ on *i*1′, or *i*4″ on *i*1″	139	18	13
*i*4 on *k*2, *i*4 on *k*2⁗, or *i*4″ on *k*2″	162	48	34
*k*2 on *c*′, *k*2″ on *c*″, or *k*2⁗ on *c*	169	19	46
k on *k*2′, *k*2″, or *k*2⁗	126	52	11

Iron pyrites is universally diffused, and is found in most description of rock. Cubes of gigantic dimensions have occurred in some of the Cornish mines; very perfect octahedrons, also of large size, are found at Persberg in Sweden; and crystals, forming pentagonal dodecahedrons (fig. 7) of three or four inches in diameter, in Elba. Various other modified crystals are found at Schnuberg in Saxony in the valley of

Planen, near Dresden, and on the island of Corsica. In Nova Scotia, at Cape St. Mary's, small, but very brilliant octahedrons occur in clay-slate. At Bay Chaleur, on the Gulf of St. Lawrence, cubic crystals are presented with their edges replaced by tangent planes, (*e* figs. 10 and 12), thus tending to rhombic dodecahedrons. They are accompanied by a botryoidal variety of the same mineral, presenting the appearance of having been fused. Beautiful octahedral crystals, as well as the *triglyphe* of Haüy, have been brought from Peru and Brazil. Alston Moor, Derbyshire, and the mining districts of Cornwall, afford it in great profusion, and under various forms, sometimes crystallized, frequently coating fluor spar, galena, and other minerals; and very brilliant crystals, remarkable for the variety of their facets, occur at Traversella in Piedmont.

In the United States iron pyrites is common to the rocks of all epochs, and of the common form, simple cubes, the localities are well known to every student. We shall mention only the principal localities of the modified crystals. At Rossie, St. Lawrence county, N. Y., examples of fig. 8, in which the edges of the cube are replaced by single planes, inclining at unequal angles on the primary planes, are not uncommon at the lead mines. These form the *cubo-dodécaèdre* of Haüy. Others exhibit portions of the planes (*a*) which have replaced the solid angles of the cube, as well as those shown by *i*, which incline on the edges (see fig. 9). Others again have simply all the solid angles of the cube replaced by tangent planes (fig. 3) forming the *cubo-octaèdre* of Haüy, or the edges replaced by exceedingly narrow tangent planes (*e* of the large fig.) or corresponding with fig. 10. The *triglyphe* of Haüy, according to Prof. Beck, also occurs at this locality, and exhibits very distinctly the striæ which indicate the threefold cleavage, and which are shown on fig. 11. Nearly all of the crystals from this locality present exceedingly brilliant mirror-like planes, and do not seem liable to tarnish. Regular octahedrons were observed by Prof. Beck at Champion, in Jefferson county, and with galena at Martinsburgh, Lewis county; also examples of figures 6 and 7, at Johnsburgh and Chester, in Warren county, accompanied by tourmaline and rutile, and possessing equal brilliancy of those from Rossie. Very handsome crystals have been found in the limestone at Shoreham, Vt., in amygdaloid at Eastport, Me., and in argillite, at Charlestown, Mass.

Hepatic Pyrites. Fer sulfuré epigène. It occurs in most of the forms assumed by common iron pyrites. Externally it presents a liver-brown color (hence its name); internally is steel-grey, with more or less lustre. Its colors appear to arise from the progress of decomposition, which often proceeds so far as to divest the substance of internal metallic lustre, without altering its form. It occurs in veins in primitive rocks.

Arsenical Iron Pyrites. Fer sulfuré arsenicale, H. Is of a paler yellow color than common iron pyrites, passing, according to the proportion of arsenic it contains, into steel-grey. When struck with the hammer, and also B B, it yields arsenical as well as sulphurous vapors. Sometimes it is magnetic. It occurs with common pyrites, and arsenical cobalt, in Sweden and in Cornwall.

Auriferous Iron Pyrites. Fer sulphuré aurifère, H. Occurs in grains of a deep yellow color; also crystallized in cubes, of which all the planes are deeply striated, and sometimes partially decomposed on the surface. The gold it contains is but small, and exists, according to Bergmann, enclosed in the pyrites in small angular grains, and therefore in a state of simple mixture.

It is found abundantly in the gold mines of Beresoff in Siberia, and in Brazil in detached crystals. It has also recently been discovered by Dr. Jackson, at Canaan and Grafton, N. H. It is occasionally found at several of the gold mines in the Southern States.

"Iron pyrites, though never employed to furnish iron, is still a valuable ore. Its sulphur is sometimes extracted by sublimation. But it is chiefly valued for the sulphate of iron, (copperas), which it affords by decomposition; — a change, which some varieties undergo much more readily than others. In this process, the sulphur receives oxygen from the air, or from moisture, and is converted into sulphuric acid. This acid combines with the oxide of iron, thus forming sulphate of iron, which is extracted by lixivation, evaporation, and crystallization. Sometimes this decomposition is spontaneous, or effected by merely exposing the pyrites to air and moisture; but some varieties must be previously roasted. — The sulphate of iron often appears on the surface of the pyrites, or the mineral, which contains it, in yellowish or white silky efflorescences, sometimes mixed with sulphate of alumina. — *Cleaveland.*"

PRISMATIC IRON PYRITES.

WHITE IRON PYRITES.

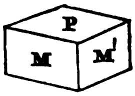
Cockscomb Pyrites, A. Sparkies, Kamkies, Strahlkies, W. Fer Sulfuré Blanc, H. Prismatic Iron Pyrites, M. J. Sperkise, *Beudant.* Pyrites rhombicus, D.

Atomic constitution same as that of the preceding, or it consists by weight of the following proportions.

Iron	45·07	45·56
Sulphur	53·35	54·34
	98·42 Berzelius.	99·90 Hatchett.

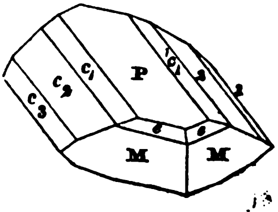
Sp. Gr. 4·69 — 4·84. H. = 6·0.

Color nearly tin-white, hence its name, occasionally tarnished with a tinge of yellow or grey. It occurs stalactitical, reniform, botryoidal; and in crystals which assume the form of modified rhombic prisms. The variety termed spear-pyrites is found only in very flat crystals, having at first sight the appearance of dodecahedrons, with triangular planes, but which are macles, consisting of similar portions of five crystals, connected as in the last of the three following figures. Cockscomb pyrites, or kamkies, is of the same description, the individuals being aggregated in such a manner as frequently to represent the crest or comb of a cock. Primary form a Right rhombic prism of about 106° and 74°; parallel to the planes of which it yields to cleavage.



M on M	106°	2′
P on M or M.	90	00
—— c1	161	24
—— c2	160	48
—— c3	130	00
M on *b*	158	42
c2 on c3	141	30

2.



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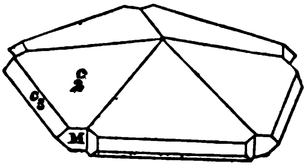
Macle.



It occurs detached and imbedded in plastic clay at Littmitz and Altsattel, near Carlsbad in Bohemia; in Derbyshire accompanying galena and fluor spar; and in the western part of Cornwall in extremely delicate stalactitic concretions, and crystals similar to fig. 3. The radiated and hepatic variety occurs in various parts of Saxony, also at Schemnitz in Hungary and Almerode in Hessia.

The crystallized variety of this mineral is rarely met with in the United States. Macled crystals similar to the figure have been found at Warwick, Orange county, N. Y., in felspar with zircon and tourmaline. Individuals having their acute solid angles replaced by a single plane parallel with the shorter diagonal of the terminal planes, or corresponding with *c*2 of fig. 2, have been found in magnesian limestone in Phillipstown, N. Y. The common massive varieties occur in Massachusetts, Connecticut and New York.

MAGNETIC IRON PYRITES.

Magnetkies, W. Fer Sulfuré, Ferrifère, Fer Sulfuré Magnetique, H. Rhombohedral Iron Pyrites, M. J. Liberkies, *Beudant.* Pyrites hexagonus, D.

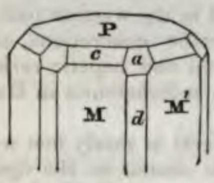
	Cornwall.	Uton.	Pyrenees.
Iron	63.5	59·85	56·37
Sulphur	36·5	40·15	43·63
	100·0 Hatchett.	100·00 Stromeyer.	100·00 Stromeyer.

	Bodenmais.	Fahlun.	Brazil.
Iron	60·52	59·723	59·636
Sulphur	38·78	40·221	40·428
	99·30 Rose.	99·914 Plattner.	100·064 Plattner.

This differs from the last described species in the proportion of its constituents, and it seems to be a mixture of simple sulphuret, or of one atom of iron and one of sulphur, with portions of bisulphuret. Haüy supposed it to be a sulphuret mixed with a little metallic iron. The formula, as given by Beudant, is FSl^2+6FSl. This requires 59·60 iron and 40·40 sulphur—numbers which almost exactly agree with the third and last two analyses by Stromeyer and Plattner.

Sp. Gr. 4·4—4·7. H.$=$3·5—4·5.

Color bronze-yellow, reddish, or brownish; subject to speedy tarnish on exposure to the air; lustre metallic. Bournon describes it as occurring in irregular six-sided prisms variously modified; the cleavage being parallel to the terminal planes of the prism, but it is rarely found crystallized. The massive varieties frequently exhibit a lamellar structure, yielding to cleavage parallel to all the planes of a Regular six-sided prism; fracture uneven passing into imperfect conchoidal. Acts on the magnet, and is said even to possess polarity. B B, it affords similar results to the preceding species; and is soluble in dilute sulphuric acid.



M on M′	120°	00′	*Bournon.*
P on M or M′	90	00	
M or M′ on *d*	150	00	
P on *a*	135	00	
—— *c*	102	13	

The crystalline varieties of this species have been noticed at Kongsberg in Norway, at Andreasberg in the Hartz, and in Brazil. The cleavable varieties are principally from Bodenmais in Bavaria, where they are associated with iolite; and the granular, compact, and massive, from Cornwall, Appin in Argylshire, Saxony, and Silesia. It has been detected in the lavas of Vesuvius, and in meteoric masses. The locality of the large and distinct crystals preserved in some of the Vienna collections is not known.

In the United States the massive variety of this species is common in connexion with magnetic iron ore and other ores, as in Essex county, N. Y., at Stafford, Vt., and Litchfield, Conn.; but perfectly developed crystals have not been met with. The cleavable variety occurs at Trumbull, Conn.

ARSENICAL IRON.

Mispickel. For Arsenical, H. Bt. Prismatic Arsenical Pyrites, M. J. Arsenik-kies, *of the Germans.* Argyrites peritomus, D.

Combination of sulphuret of iron and arseniuret of iron.

	Freyberg.	Freyberg.	Freyberg.
Iron	34·94	36·04	33·98
Arsenic	43·42	42·88	45·74
Sulphur	20·13	21·08	19·00
	98·49 Chevreul.	100·00 Stromeyer.	99·32 Thomson.

The analysis by Dr. Thomson comes nearest to the formula (FSl^2+FAs^2) which Berzelius has given for this species, and which requires 45·53 arsenic, 33·57 iron, and 19·90 sulphur.

Sp. Gr. 5·7 — 6·2. H. = 5·5 — 6·0.

It is nearly of a tin-white color, sometimes with a tinge of yellow. It occurs massive, acicular, and crystallized in the form of a Right rhombic prism, parallel to whose planes it may be cleaved (to the lateral planes most readily), affording, by the planes so produced, angles of 111° 12′ and 68° 48′; this prism is considered the primary form of mispickel; fracture uneven, with a metallic lustre. It gives fire with steel, and the sparks are attended with a little train of white smoke, having an alliaceous odor. B B, on charcoal it gives out copious arsenical vapors, and forms a globule of nearly pure sulphuret of iron, which attracts the magnetic needle.

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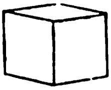

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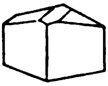

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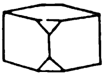

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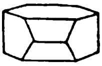

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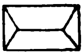
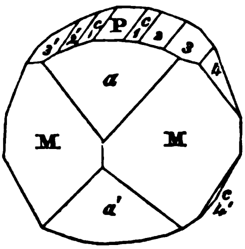


Fig. 1, the primary; a right rhombic prism. Fig. 2, the same, of which each terminal plane is in part replaced by two faces slightly inclining on the acute angles of the prism. Fig. 3 exhibits the primary prism modified by triangular planes replacing each obtuse solid angle; these planes are further advanced in fig. 4, and still further in fig. 5; having totally replaced the terminal faces, and reduced the lateral planes to triangles, meeting two and two at the acute edges of the prism.



M on M	111°	12′	
P on M or M	90	00	
M on *a*	136	20	
—— *c*3	117	2	
—— *c*4	116	10	
a on *a′*	121	52	
*c*1 on *c*1′ over P	154	56	H.
*c*2 on *c*1′	142	00	*c. g.*
*c*3 on *c*3′	118	5	
*c*4 on *c*4	79	80	
*c*4 on *c*4′	100	80	

It chiefly occurs in the veins and beds of primitive mountains, accompanying ores of silver, lead, and tin. It is found abundantly at Freyberg, Munzig, and other mining districts of Saxony; at Andreasberg in the Hartz; at Joachimsthal in Bohemia; and at Wheal Maudlin and many others of the Cornish mines; and Tunaberg in Sweden.

Argentiferous Arsenical Iron. Weisserz, W. Fer Arsenical argentifère, H. It is whiter than pure arsenical iron, being of a somewhat silvery-white; but agrees with it in all other characters, except that it contains from 1 to 15 per cent. of silver. That of Andreasberg consists of 44 iron, 35 arsenic, 13 silver, and 4 antimony. — *Klaproth.*

At Freyberg and Braunsdorf in Saxony, it is worked for the silver it contains.

ARSENICAL SULPHURET OF IRON AND COBALT. Danaite of *Hayes.*[*] It has been found that cobalt sometimes takes the place of a portion of the iron in this species, without producing any marked changes in its chemical characters, or in its general physical characters. It would seem, however, that a slight difference exists in the measurement of the angles, which is probably to be attributed to the presence of the cobalt. This difference was first observed by Scheerer in the specimen examined by him from Modum in Norway,[†] and it seems also to exist in the crystals from Franconia, as measured by Mr. Teschemacher, and which contained nearly the same proportion of cobalt. Scheerer states the fact, but does not record the measurements. The following are the analyses of four specimens of arsenical iron containing cobalt.

	Modum.	Modum.	Modum.	Franconia, N. H.
Arsenic	47·55	46·76	47·45	41·44
Iron	26·54	26·36	30·91	32·94
Cobalt	8·31	9·01	4·75	6·45
Sulphur	17·57	17·34	17·48	17·84
	99·97 Scheerer.	100·47 Scheerer.	100·57 Wöhler.	98·57 Hayes.[‡]

Rammelsberg (*Handwörterbuch*, i. 47) has thus stated the atomic constitution of this mineral $(F,Cb)+Sl^2+(F,Cb)As^2$.[§]

The subjoined figure was drawn by Mr. Teschemacher, and represents the crystals of this mineral from Franconia, N. H.,

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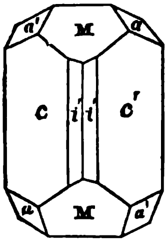
[*] In honor of the late Prof. J. F. Dana, who first discovered cobalt in this mineral. — See Amer. Jour. of Science, viii. 1824. p. 302.

[†] Berzelius' Rapport Annuel, 1833, p. 211. Scheerer found that the proportion of cobalt was not constant, and that the largest crystals contained the least of it.

[‡] Amer. Jour. of Science, xxiv. 388.

[§] In transcribing the formulas from different writers, the symbols, excepting in the cases of some of the chemical formulæ, have always been changed to those given in the table at the close of the Introduction to this volume. This seemed necessary in order to preserve a general uniformity. [AM. ED.]

The values of the angles were determined by him by means of the reflecting goniometer.



M on M	68° 00'
M on M over summit	112 00
a on *a'*	121 30
c on *c*	100 15

This rare and interesting mineral, was discovered by Prof. J. F. Dana in gneiss, accompanying copper pyrites, at Franconia, N. H. The most highly polished crystals are imbedded in layers of brownish quartz, interspersed with copper pyrites. But specimens are no longer found at this locality.

PLEISTO*-MAGNETIC IRON.

COMMON MAGNETIC IRON ORE.

Magneteisenstein, W. Fer Oxydulé, H. Bt. Octahedral Iron Ore, M. Magnetic Iron Ore, J. A. Oxydulated Iron, *Phillips*. Siderite Aimant, *Necker*. Ferruso-ferric oxide. Magnetic Oxide of Iron, *Cleaveland*. Siderus octahedrus, D.

The pure crystallized specimens of this species, consist entirely of iron and oxygen, united, according to Berzelius, in the proportion of two atoms peroxide to one of protoxide. Formula, as given by Dr. Thomson, $\underline{F}\underset{\cdot}{F}^{2}$. The whole content of oxygen is 28·22, of iron 71·78; or it contains, in 100 parts 69·02 peroxide, and 30·98 protoxide of iron. Formula, according to Berzelius: $\dot{F}e\dddot{\bar{F}}$. Mohs thus states it: $\ddot{F}e+2\dddot{F}e$.

It occurs earthy, compact, lamelliform, and crystallized in the Regular octahedron, which is considered to be its primary form; structure imperfectly lamellar parallel to the planes of the octahedron; fracture uneven, or conchoidal with a splendent lustre; color iron black, with a shining or glimmering metallic lustre; streak black. It is highly magnetic, with polarity, especially the massive (*native loadstone* , and attracts iron filings. B B, it becomes brown, and loses its influence on the magnet, but does not fuse. Colors glass of borax in the oxydating flame deep red, which becomes dingy yellow and impure on cooling; and in the reducing flame bottle-green. Soluble in heated muriatic, but not in nitric acid.

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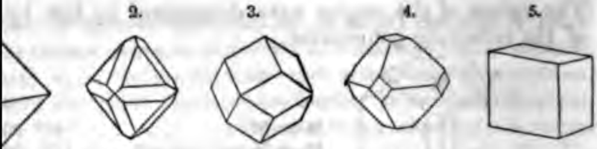
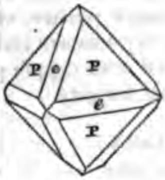
* From the Greek πλεῖστος, alluding to its high degree of magnetism, from its containing a large portion of iron. The term oxydulated iron, by which this species has been distinguished in the former editions of this work, has been changed to one which conveys an accurate idea of its character, as regards one of its essential physical properties, while it necessarily supposes a greater proportion of iron than is contained in the next species. (Am. Ed.)



1, the primary; the regular octahedron. Fig. 2, the same, of all the edges are replaced by planes: this replacement has pro further, and the planes are complete in fig. 3, the rhombic dodron; fig. 4, the primary, having each of its solid angels replaced by planes, which by their complete extension, have changed the figo a cube, fig. 5.*



P on P	109°	28′ H.
P on *e* or P on *e*.	144	44
e on *e*	120	00

is species is most common in primitive countries, geneorming beds and large irregular masses; and accompanied rnblende, granular limestone, and garnet; occasionally y blende, pyrites, fluor, tin, and galena. The extensive of Arendal in Norway, and almost all the celebrated iron of Sweden, consist of massive magnetic iron. Danne-

Nova Scotia, at Digby Neck, detached crystals of magnetic oxide of iron are found in the water courses connected with the trap rocks, and also lining the cavities of large masses of this ore which are imbedded in the trap. They are frequently united with purple amethyst.

In the United States, localities of this species are very numerous, and extend with very little interruption from Canada to New Jersey. It will suffice to name a few only of those which have afforded the finest crystals, or have been longest celebrated for their application to the manufacture of iron, particularly of bar iron. These are those of Orange, Clinton and Essex counties, N. Y., of Franconia, N. H., of Troy, Vt., and of Sussex and of Morris counties, N. J., in each of which the ore appears in immense beds, or irregular deposits, included in granite, gneiss or hornblende rock, and associated with various crystallized minerals. The Sterling mine in Orange county, N. Y., is supposed to cover a surface of about thirty acres. The mine at Sucasunny, Morris county, N. J., has been wrought to a greater depth than any other in the United States, and in many respects it bears a remarkable resemblance to the noted Danemora mine in Sweden. It is a singular fact, however, that this deposit rarely affords any examples of the crystallization of this species, while the other localities mentioned supply them abundantly and in great perfection. According to Prof. Beck, the O'Niel mine, Orange county, N. Y., sometimes affords octahedral crystals in which one solid angle only is replaced, and rarely, those in which no portions of the primary planes are visible — or perfect cubes — a form in which it has been rarely if ever before discovered. The chlorite slate of Marlboro' and Bridgewater, Vt., and the epidote of Franconia and Lisbon, N. H., have hitherto presented the largest imbedded individual crystals, in octahedræ and dodahedræ. Dr. Jackson also cites several other localities in the same State, as at Amherst and Manchester in granite.

The pleisto-magnetic iron ores of the United States are for the most part, better adapted for the manufacture of malleable, than of cast iron. They do not so readily unite with carbon to produce that grey, soft condition which is found in the superior cast iron made from the hematitic and clay iron ores; and they require much greater heat for their reduction, and perfect metallization. They probably supply about one half of all the pig iron annually manufactured in the United States, and nearly all of the malleable iron obtained directly from the ore, is derived from this species, either with anthracite or charcoal. It frequently contains small portions of oxide of titanium, which in the process of smelting, is reduced and crystallized in minute brilliant cubes at the sides and bottom of the furnace. These seem to have been first observed by Dr. Wollaston, but they are now common in all countries. It sometimes also contains oxide of chrome and manganese; and the latter is carried through the same reduction as the iron, and exists afterwards in combination with the metallic iron, to which, in the opinion of some, it communicates additional strength.

Native Magnet. Masses of this ore, which are tolerably free from earthy impurities, and of a crystalline or granular structure, possess the power not only of moving the magnetic needle, but also a sensible inherent polarity, by which, if two extremities of a small fragment be alternately presented to the same pole of a magnetic needle, one extremity will attract, and the other repel the needle. The magnetism of this variety is also shown by its power of attracting iron filings.

Iron Sand of Jameson. This is the common black sand used at merchants' desks. It occurs in small octahedral crystals more or less broken and rounded by attrition, and owes its origin to the disentegration of the matrix in which it had originally crystallized. Thus, according to Prof. Silliman, the chlorite slate near New Haven, Conn., abounds with minute octahedral crystals, which, by the action of the waves, have been liberated, and form the black magnetic sand of the beach.

Earthy Pleisto-magnetic Iron. This variety is less readily attracted by the magnet. It is more or less mixed with lime or alumina, is granular, of a grey and bluish-black color, and of an uneven earthy fracture. It usually soils the fingers.

OLIGISTO[*]-MAGNETIC IRON.

SPECULAR[†] IRON.

Eisenglanz, W. Fer Oligiste, H. Fer Speculaire, Br. Iron Glance, J. Fer Oxydé, *Berzelius.* Eisenoxyd, L. Rhombohedral Iron Ore, M. Specular Oxide of Iron, *Cleaveland.* Siderus rhombohedrus, D.

The pure crystals of this species consist entirely of peroxide of iron, in the proportion of iron 69·34, to oxygen 30·66. Symbol $\underset{\cdot}{F}$

Sp. Gr. 5·0 — 3. H. = 5·5 — 6·5.

It is considerably magnetic, especially the highly crystalline, but does not, like the preceding species, attract iron filings. It occurs lamellar, and crystallized in many forms, which are derived from a slightly Acute rhomboid of 86° 10′ and 93° 50′, the structure of the crystallized being lamellar, and reducible into the form of its primary crystal; fracture uneven; passing into conchoidal; color deep steel-grey, with a brilliant and often iridescent tarnish externally; internally it possesses a shining lustre; opake in large fragments, but the edges of thin laminæ present a blood-red color by transmitted light. Streak cherry-red, or reddish-brown; is infusible without addition, but with borax forms a green or yellow glass, like pure oxide of iron.

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[*] From the Greek, ολιγιστος, in allusion to its slight magnetic property, compared with the preceding species.

[†] Specular, from its brilliancy.

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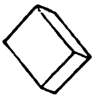

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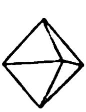

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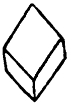

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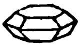

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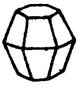

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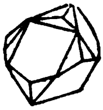
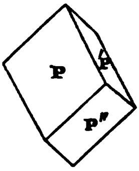
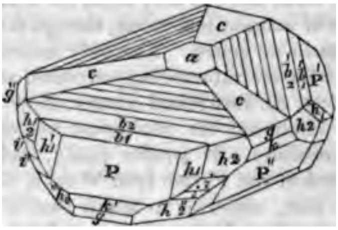


Fig. 1, the primary; a slightly acute rhomboid. Fig. 2, an octahedron, arising from the replacement of the upper and lower acute angles of the primary. Fig. 3, an acute rhomboid, of which only the upper plane, and that parallel with it, correspond with the planes of the primary. The upper and lower lateral faces of fig. 4 belong alternately to the primary. In fig. 5 none of the primary planes are visible. Of fig. 6 all the larger planes belong to the primary, and the small triangular faces result from the replacement of its lateral and lower angles by two planes, and the upper acute angle by three planes. Sometimes the edges and angles are so rounded that the crystals assume a lenticular form.

The crystals of this substance, however, and especially those from Elba, most commonly occur in the general form of the second of the two following figures.

Primary.





P on P′	86°	10′	P on *h*2 or *h*2′	154°	20′
P on P″	93	50	—— *k*′ or P″ on *k*	147	20
P or P′ on *a*	122	40	*a* on *c*	168	30
—— —— *b*1	178	50	*h*2 on *h*2 or *h*2′ on *h*2′ . . .	128	32
—— —— *b*2 . . . , ...	159	35	*h*2 on *i* or *h*2′ on *i*	161	40
P on *g*′ or P′ on *g*	140	00	*i* on *i*	159	12
P on *h*1 or *h*1′	179	30	*h*2 on *g* or *h*2′ on *g*′	144	20

It occurs in transition and primitive rocks, both in beds and veins, and is accompanied by pleisto-magnetic iron, &c.

The mines of this substance in the Isle of Elba are of great extent, and are said to have been worked upwards of 3000 years; the surfaces of the splendid crystals from this locality frequently present the most magnificent tarnish-colors. It is also met with in Saxony; in Bohemia in beds of mica-slate; in specimens consisting of large crystalline plates, grouped together in the form of rosettes, accompanying adularia at St.

Gothard; at Arendal in Norway; at Langbanshyttan in Sweden; in South America; and in Siberia. In England, it occurs finely crystallized in one or two of the Cornish mines. Very resplendent crystalline plates, sometimes of considerable dimensions, and intersecting each other at various angles, are formed by sublimation in the fissures of lava at Stromboli and Lipari; likewise, though in smaller individuals, at Etna, Vesuvius, and in Auvergne. A micaceous variety, consisting of minute shining scales, either loose or slightly cohering, which appears by reflected light of an iron-black, sometimes tinged red, and by transmitted light, blood-red — occurs at Tavistock in Devonshire, and near Dunkeld in Perthshire. In Nova Scotia, specular iron ore forms veins in the trap rocks at several places along the shores of the Bay of Fundy, and is sometimes in crystals, which present portions of the planes of the primary rhomboid. The most beautiful specimens are from Sandy Cove, where it is associated with siliceous sinter and Laumonite, and sometimes with agate and jasper.

Of this species, unless we include under the same head, as some writers have done, all the hematite ores, the earthy-red oxide of iron, and the clay ores, the United States offers but few deposits of economical value, though frequently presenting it in small seams or veins. The only mines which are extensively explored for manufacturing purposes, are those of Edwards and Governeur, St. Lawrence county, New York, where, according to Prof. Emmons, its geological associates are gneiss and primary limestone. It smelts easily, and as the process is now conducted at the Parish Iron Works, Rossie, it affords a valuable cast iron, superior to much that is made from the pleistomagnetic ore. Low tabular and lenticular shaped crystals, bearing a striking resemblance to many of the specimens from Elba, are occasionally found in the cavities of this ore, and they possess an almost equal degree of brilliancy and iridescence, compared with those from that celebrated locality.

The ore obtained from the celebrated "Iron Mountain" in Missouri, is of this species, and unless the accounts be greatly exaggerated, it is unprecedented as to quantity, so far as any thing is known of mines in America.

At Hawley and Montague, Mass., the micaceous variety, in small shining scales, feebly cohering, forms veins in mica-slate; and at Lubec, Maine, it is attached to masses of siliceous slate. At Piermont, N. H., it forms considerable beds in gneiss.

Specular iron ore is rarely met with to a sufficient extent to be wrought in Europe, though the Elba mine was formerly explored to a great extent, and for a long period of time by the

Romans; and is yet explored, the ore being removed to the continent where wood is more abundant for supplying the charcoal used in smelting.

FRANKLINITE.*

Franklinite, ***Berthier.*** **Dodecahedral Iron Ore, M. Zinc Oxydé Ferrifère, H. Siderite Zincifère,** ***Necker.*** **Siderus Zinciferus, D.**

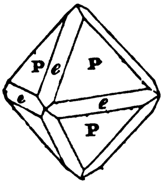
Combination of the peroxide of iron, with the oxide of zinc, and red oxide of manganese.

	Franklin, New Jersey.		
Peroxide of iron	66·0	66·10	68·88
Oxide of zinc	17·0	17·43	10·81
Sesquioxide of manganese	16·0	14·96	18·17
Silica	0·0	2·00	0·40
Alumina	0·0	0·00	0·73
	100·0 Berthier.	98·69 Thomson.	98·99 Abich.

Taking the two first analyses which nearly agree, and dividing by the atomic weights, we obtain numbers approaching nearly to four atoms peroxide of iron, one atom sesquioxide of manganese, one atom oxide of zinc. Dr. Thomson supposes the iron to act the part of an acid, and expresses the constitution of the mineral thus: MnF^2+ZF^2.

Sp. Gr. 5·0 — 5·1. H. = 6·0 — 6·5.

This mineral occurs in grains or in granular masses composed of imperfect crystals, frequently exhibiting the planes of the Regular octahedron, its primary form. These crystals are often replaced on their edges, but more frequently bounded by irregular faces produced by contact; the structure is lamellar, parallel to the planes of the regular octahedron; brittle; fracture conchoidal; streak deep reddish-brown — distinguishing it from pleisto-magnetic iron, the streak of which is black. Acts slightly on the magnet; soluble without effervescence in heated muriatic acid. At a high temperature the zinc is driven off; and a hard compound of iron and manganese remains. B B, with borax it forms a green glass, which when completely saturated becomes red, and on cooling assumes a greenish-brown color, and remains transparent; with salt of phosphorus it yields a yellowish-grey glass, and with soda is insoluble.



P on P	109° 25′
P on e	144 40

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* Franklinite, in honor of the celebrated Franklin.

The measurements by the reflective goniometer prove the regular octahedron to be its primary form.

It occurs at Franklin, Sterling and Sparta in Sussex county, N. J., accompanying the red oxide of zinc, and is frequently imbedded in calcareous spar, and associated with quartz, yellowish-green garnet, and other substances. The locality which has afforded the finest specimens is the Sterling zinc mine, where perfect crystals, or groups of crystals, similar to the above figure, are often found from six to eight inches in circumference with highly polished faces. The most magnificent crystal ever found is now in the possession of Dr. Fowler, and measures sixteen inches round the base! As this substance has the same primary form with pleisto-magnetic iron ore, and presents precisely the same secondary modifications, it would be difficult to distinguish the crystals of one from the other, were there not discernible a superior blackness in the lustre of the faces of the Franklinite, and greater inequalities of surface. It is also mentioned as accompanying ores of zinc, in amorphous masses, at the mines of Altenberg near Aix-la-Chapelle.

HYDROUS PEROXIDE OF IRON.

LIMONITE.

Prismatic Iron Ore, M. J. (in part). Brown Iron Ore. Onegite. Pyrrhosiderite, Limonite, *Beudant.* Fer Hydro-oxidé, *Bournon.* Siderus hæmaticus, D.

Peroxide of iron combined with water.

Peroxide of iron	80·50	79·0	82·0	84·0	81·0	78·0	73·0	76·0	94·0	76·8
Sesquiox. of mangan.	trace	2·0	2·0	1·0	0·0	trace	1·0	2·0	trace	8·2
Water	16·00	15·0	14·0	11·0	12·0	13·0	14·0	14·0	3·0	10·0
Silica	2·25	3·0	1·0	2·0	4·0	6·0	9·0	5·0	2·0	4·3
Alumina	0·00	0·0	trace	0·0	0·0	1·0	0·0	0·0	0·0	0·0
	98·75*	99·0†	99·0†	98·0†	97·0†	99·0†	97·0†	97·0†	99·0†	99·3‡

The first three specimens analyzed belong to the purest form of this mineral, and they seem to indicate an approach to a uniformity in the composition of this mineral. From the mean of these, if we suppose the silica to be united with peroxide of iron, as a tersilicate, and to be accidental, we obtain one atom water, and one of peroxide of iron. Formula, $\underset{.}{F}Aq$. This gives about 60 parts of metallic iron in 100 parts of the ore.

Sp. Gr. 3·50. H. = 5·0 — 5·5.

This mineral presents considerable diversity of external appearance. It is found both crystallized and massive. The crystals are small; externally black, and very brilliant; internally blackish-brown. Streak yellowish-brown; brittle; and opake. It also occurs in extremely tender stalactites, of which the fibres radiate from the centre; and compact. The primary form appears to be a Right rectangular prism, the only cleavage being parallel to the plane M. The crystals which have been observed in cubes and octahedrons, are obviously pseudomorphous, taking the place of iron pyrites. B B, in the matrass it gives off water, the remainder being red oxide of iron; with borax it forms a yellowish-green glass. Occasionally it acts on the magnet, and does so always after exposure to heat. When rubbed upon paper some varieties leave a black mark like manganese, for which they may occasionally be mistaken.

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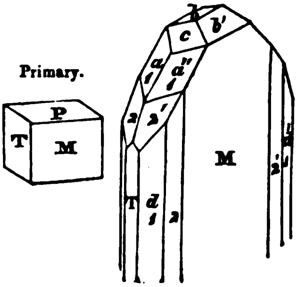
* Ulmann, Hoffman's Miner., iv. 188. The specimen was stilpnosiderite.

† D'Aubuisson, Ann. de Chim., lxxv. 237. The first two specimens brown hematites. The third and fourth compact brown hematites. The fifth and seventh etites. The sixth lenticular iron ore. The eighth red hæmatite.

‡ C. T. Jackson. Compact red hæmatite, from Aroostook River, Maine.



P on M or T	90°	00′
T on M	90	00
M on *a*2′	135	5
— — *b*	121	45
— — *d*1	117	50
*a*1 — *a*1′	125	30
*a*2 — *a*2′	149	24
b — *b*′	117	30
c — *d*1	120	42
c — *b* or *b*′	135	20
b — *a*2 or *b*′ or *a*2′ . .	121	25
*a*1 — *d*1	129	30
*a*2 — *d*1	153	25
*d*1 — *d*1 over T	130	40
*a*2 or *a*2′ on *e*	147	00

The second figure represents the crystals from the vicinity of Bristol.

It occurs at Clifton near Bristol in quartzose geodes, in the form of mamillary masses, and often enclosed in quartz crystals; on compact hard iron-stone at Botallack, and in highly brilliant crystals near Lostwithiel, in Cornwall; also disposed in groups at Lake Onega in Siberia; acicular and capillary in quartz from Oberstein, and amethyst from Petrosbotzky, Russia. Also in the same form penetrating amethyst in Nova Scotia.

GOETHITE.[*] Rubin-Glimmer, *Haussman*. Goethite, *Lenz*. Lepidokrokite, *Ullmann*. Color brownish-red, by reflection yellowish, and of a brilliant red when transparent and viewed in strong light. Streak orange-red; lustre metallic adamantine. Primary form, either a right rhomboidal or rectangular prism. Occurs in minute laminæ or tables modified on their edges by oblique facets. The principal locality of this species is the Hollerterzug, in the Westerwald, Germany. It is not a common variety.

RED HÆMATITE.[†] Red Iron Ore. Red Iron-stone, J. Rother Eisenstein, W. The more compact hæmatites sometimes slightly affect the magnet, rendering it probable that they contain a small portion of the protoxide of iron. None of them are blood-red by transmitted light; and they never assume a crystalline form.

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[*] In honor of the celebrated German poet Goëthe.

[†] Hæmatite, from the Greek, in allusion to its blood-red color. Now, however, the original meaning of the term is so far lost sight of, that we have *brown* and even *black* hæmatite. This variety has sometimes been classed with specular iron, but it presents forms never assumed by that ore, contains water, and passes, by imperceptible shades, into the common brown hæmatites. I have therefore included it, with the brown hæmatites, among the varieties of the present species. [AM. ED.]

The *fibrous* variety (Rother Glaskopf, W. Fer oligiste concretionné, H.) has externally a bluish or iron-grey color, and presents either a metallic lustre, or is red and without lustre; internally it is red or brownish-red. It occurs in botryoidal masses, or in stalactites, formed of concentric coats, and having a fibrous or radiated structure.

It occurs abundantly in Saxony, Bohemia, the Palatinate, Silesia, and the Hartz; also near Ulverstone in Lancashire, and in smaller quantities in many parts of England and Scotland. In New Brunswick, at Woodstock, compact red hæmatite form immense beds in shale. Red hæmatite affords excellent iron both cast and malleable. When ground to fine powder it is employed in the polishing of metals. The *scaly* variety (Rother Eisenrahm, W.) occurs in slightly cohering scales or particles of a red color with a tinge of brown, and opake; the lustre is somewhat metallic. It is unctuous to the touch, and stains the fingers. It accompanies the preceding, but is principally known from Cattas Altas in the Brazils.

BROWN HÆMATITE. Fibrous Brown Iron Ore. Brauner Glaskopf, W. Fer Oxidé Hæmatite, H. Specific gravity 3·7—4·0. Is of a clove or blackish-brown color; externally is often steel-grey and splendent. It is more finely fibrous than the red hæmatite, sometimes with a silky lustre, and often radiated; in the other direction it is generally concentric lamellar, the colors being disposed in bands of brown of various shades. It occurs in mamillary and botryoidal masses, in stalactites and tubes. It is brittle.

It forms beds in limestone and other secondary rocks in most European countries; affording materials for extensive iron works in Bohemia, Styria, &c. Sweden and Lapland, which abound in magnetic iron, contain but small quantities of the brown or red hæmatites. But, according to Berthier, it supplies more than three-fourths of all the iron furnaces in France.

In Scotland it forms veins in sandstone at Cumberhead in Lanarkshire; at Sandloge in the Shetland Isles; and in Hoy, one of the Orkneys. In Cornwall it occurs at Botallack near the Land's End, and in Tin Croft mine near Redruth. It affords a very tough, compact cast iron, and is convertible also into malleable iron of superior quality. In the United States the best iron, both malleable and cast, is obtained from the brown hæmatite ore.

Scaly and Ochrey Brown Iron are varieties of the same species more or less decomposed, presenting either slightly cohering scales and particles, or having an earthy consistence which is meagre to the touch, and soils the fingers. *Bog iron ore*, the *morasterz*, *sumpferz*, *wiesenerz* of the Germans, is of recent formation; it arises from the decomposition of certain rocks over which water passes, and is deposited by it in low and marshy situations. It frequently contains traces of phosphoric acid, and forms considerable repositories in Germany, Poland, and Russia. The variety termed *bohnenerz* or *pea-ore*, consists of concentric globuliform concretions, imbedded either in friable or compact brown hæmatite; at St. Stephens in Styria this kind of ore yields about 33 per cent. of iron. Brown iron ore not unfrequently assumes the form of other minerals; at Huttenberg in Carinthia, for instance, it has evidently taken the place of sparry iron; and at Beresof in Siberia occupies large cubical pseudo-crystals of iron pyrites.—*Allan's Manual.*

The most valuable varieties of this species, brown and red hæmatite, are plentifully distributed throughout the United States, as at Bennington, Vt., on the Aroostook river, Me., at Salisbury and Kent, Conn., Richmond, Lenox and West Stockbridge, Mass., Cumberland, R. I., Franklin and Hamburg, Sussex county, N. J., and near Fishkill and Ameniaville, Dutchess county, N. Y. It occurs also in extensive beds in several of the Western States. The beautiful imitative forms which these ores are known to assume, are found at all of these localities, but the dependent stalactitico-botryoidal masses, of a brilliant glossy black color, which are sometimes met with in the cavities at Salisbury, are by far the most interesting. Those from Dutchess county, are sometimes covered by a layer of grey oxide of manganese, of a radiated structure. Most of these hæmatite ores also contain oxide of zinc, which condenses on the sides of the chimneys where they have been smelted. United with proper fluxes, all these varieties are readily reduced in the smelting furnaces, and afford a metal of superior strength and softness. The bog-iron ores are also very abundant throughout the United States, but they are apt to yield what is termed *cold short* iron, which cannot be safely used in the manufacture of wire, or seldom even of sheet or plate iron, though it is well adapted for casting.

CLAY IRON STONE, OR ARGILLACEOUS IRON ORE. This is composed of peroxide of iron united with variable proportions of lime, magnesia, alumina, silica, and frequently with carbonate of iron. It more properly comes under the species carbonate of iron, which see.

STILPNOSIDERITE.[*] *Ullmann.* Specific gravity 3·6 — 3·65. Hardness = 4·5. In botryoidal groups, massive, and dendritic; of a black or brownish-black color, with a splendent lustre both externally and internally; fracture conchoidal; opake; brittle. Streak yellowish-brown. It becomes black B B, but does not fuse; and tinges borax dark olive-green, though it is not melted itself.

It occurs at Rashau and Schiebenberg in Saxony, in Thuringia, Nassau, and the Hartz, frequently associated with brown hæmatite, to which it appears to be nearly allied.

CRONSTEDTITE.[†]

Rhombohedral Melane Mica, M. Cronstedit, L. Sideroschislite. Arealus foliaceus. D.

Contains oxide of iron 58·85, silica 22·45, oxide of manganese 2·89, magnesia 5·08, water 10·70. — *Steinmann.*

It is a hydrous silicate of iron. Formula: $\underline{F}S+Aq$.

Sp. Gr. 3·3 — 3·35. H. = 2·5.

Massive and crystallized; the massive consisting of black and opake fibres, having a brilliant lustre; the crystallized occasionally in separate six-sided prisms, more often however the prisms adhere laterally. In thin laminæ, somewhat elastic; streak dark leek-green; cleavage distinct perpendicular to the axis. B B, it intumesces slightly, but does not melt. With borax it affords with difficulty a hard, black, and opake enamel. When reduced to powder it gelatinizes in concentrated muriatic acid. It is found near Przibram in Bohemia with carbonate of iron; in diverging groups at Wheal Maudlin in Cornwall; and associated with quartz and magnetic pyrites at the mines of Conghonas do Campo in Brazil.

Dr. Thomson has described an *anhydrous silicate of iron* (*Outlines, &c.*, i. p. 461,) from one of the Mourne Mountains in Ireland, which agrees with this in containing one atom of protoxide of iron and one of silica, but has its hardness increased to 4, and its specific gravity to 3·884, apparently simply by its containing no water. It gave protoxide of iron 68·60, silica 29·60, protoxide of manganese 1·85.

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[*] From the Greek, signifying a shining ore of iron.

[†] In honor of Cronstedt, the Swedish mineralogist; named by Prof. Steinmann.

PINGUITE.

Breithaupt. (*Schweigger's Jahrbuch*, lv. 303.)

Contains per and protoxide of iron 35·60, silica 36·90, alumina 1·80, magnesia 0·45, oxide of manganese 0.14, water 25·10. — *Kersten.*

Sp. Gr. 2·315. H. under 2·0.

Pinguite occurs in masses of a siskin or oil-green color; with a slightly resinous lustre; and conchoidal or uneven fracture; feels greasy; does not adhere to the tongue, and emits a feeble argillaceous odor when struck. Streak lighter than the mineral. Extremely soft, resembling newly made soup.

In the matrass it yields much water. B B, *per se*, it becomes black, but only fuses on the edges. With borax it melts easily, exhibiting the presence of iron; as also with salt of phosphorus, in which a skeleton of silica remains. Occurs in a vein of barytes at Wolkenstein in the Erzebirge, and has been severally described by Breithaupt, Freisleben, and Beckmann.

CHLOROPAL.

Bernhardi and Brandes, (*Schweigger's Jahrbuch*, v. 29.)

Sp. Gr. 1·7 — 2·0. H. = 3·0 — 4·0.

Of this there are two varieties; the one massive and compact, the other earthy. Color pistachio-green; opake, or feebly translucent on the edges; fracture conchoidal and splintery; it does not phosphoresce. Infusible, *per se*, B B, but with soda melts into a clear glass, showing some red spots. The massive consists, according to Brandes, of oxide of iron 33·3, silica 46·0, magnesia 2·0, alumina 1·0, water 18·0, manganese a trace.*

These numbers correspond with three atoms silica, one atom protoxide of iron, and two atoms water. The Ceylon variety, analyzed by Dr. Thomson, gave a different result, and will probably be distinguished by a new name.

It occurs associated with opal at Unghwar in Hungary, and appears to be closely allied to green iron-earth. It has been brought also from Ceylon.

CHAMOISITE.

Kobell. Berthier. (*Ann. des Mines*, v. 393.)

Contains oxide of iron 50·5, silica 14·5, alumina 6·6, water

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* Analysis by Bernhardi and Brandes.

14·7, carbonate of lime 14·4, carbonate of magnesia 1·2. It is not certain how many of these constituents are essential.

Sp. Gr. 3·0 — 3·4. Pretty hard.

Occurs massive, of a greenish-grey or black color, and has a granular earthy fracture; magnetic. Is soluble in acids, with the exception of its silica, and gives off water when heated in the matrass. It is found in the calcareous deposit of Mount Chamoison in the Valais; whence it is advantageously extracted as an ore of iron.

SIDEROSCHISOLITE.

Wernekinck. (*Pogg. Ann.*, i. 387.) Hydrous disilicate of Iron *of Thomson.*

Contains protoxide of iron 75·16, silica 16·30, alumina 4·10, water 7·30 — *Wernekinck.*

The above numbers, supposing the alumina to be accidental, give very nearly one atom each of silica and water to two atoms of protoxide of iron, thus showing it to be a hydrous disilicate of iron. Formula: $\underline{F}^2\dot{S}+Aq.$

Sp. Gr. 3·0. H = 2·0 — 3·0.

Primary form a Rhomboid, presenting only a single cleavage, which is perpendicular to the axis. This mineral occurs in small sided prisms of a black color. Its streak is green; its lustre brilliant; it becomes magnetic and black from exposure to heat. B B, is readily fusible into a black magnetic glass; and is soluble in acids.

It occurs at Conghonas do Campo in the Brazils.

HISINGERITE.

Hisingerite, *Berzelius.* (*Afhandl.* i. *Fysik.* &c., iii. S. 304.) Thraulite, *Kobell.* Siderus Hisingeri, D.

	Bodenmais.	Bodenmais.	Kiddarkytton.
Peroxide of iron	49·869.	50·86	Per and protox. 44·39
Silica	31·775	31·28	36·30
Water	20·000	19·12	20·70
	100·764 Hisinger.	101·26 Kobell.	101·39 Hisinger.

We obtain from the two first analyses one and a half atom silica, one atom peroxide of iron, and a little less than two atoms water. But according to Hisinger the mineral contains both oxides of iron, and he has given the following formula, answering to the last analysis: $\dot{Fe}\ddot{Si}+\overset{\dots}{\overline{Fe}}\ddot{Si}+6\dot{\overline{H}}$.*

Sp. Gr. 3·04.

Occurs in masses which are cleavable in one direction only, and possess a foliated structure. Black; dull; with an earthy fracture; streak greyish-green; capable of being cut with the knife. B B, at a gentle heat becomes magnetic; at a more elevated temperature fuses into an opake black dull globule; and with borax forms a yellowish glass.

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* The formula requires of protoxide 13·55, of peroxide 30·13, of silica 35·55, of water 20·27.

It is found in the cavities of calcareous spar, in the parish of Suarta in Sudermanland, Sweden; but is not common. The thulite is found at Riddarkyttan in Westmarland, and at Bodenmais, in Germany.

YENITE.*

Lievrite, J. Diprismatic Iron Ore, M. Hyait, *Haus.* Fer Calcareo-Siliceux, H. Siderus rhombicus, D.

Combination of silica, protoxide of iron, and lime.

	Elba.	Elba.	Elba.	Hungary.	Elba.
Protoxide of iron	55·0	52·54	31·900	42.30	33·07
Peroxide of iron	0·0	0·00	23·000	15·78	24·58
Silica	28·0	29·28	29·278	34·60	29·83
Lime	12·0	13·78	13·779	5·84	12·44
Oxide of manganese	3·0	1·59	1·587	0·28	1·50
Alumina	0·6	0·61	0·614	0·12	0·00
Water	0·0	1·27	1·268	1·00	0·00
	98·6†	99·07‡	101·426 Kobell.	100·00 Wehrle.	101·42 Rammelsberg.

The formula which has been given from the two first analyses is no longer tenable, as the later analyses by Kobell and Rammelsberg have shown the presence also of peroxide of iron. Rammelsberg has given the following formula:

$$\left.\begin{matrix}\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{S}}\mathrm{i}\\ 2\dot{\mathrm{F}}\mathrm{e}^3\dddot{\mathrm{S}}\mathrm{i}\end{matrix}\right\}+\dddot{\rlap{-}\mathrm{F}}\mathrm{e}^2\dddot{\mathrm{S}}\mathrm{i}.$$

This requires 28·98 silica, 24·56 peroxide of iron, 33·06 protoxide of iron, lime 13·40; — answering very nearly to the third and last analyses.

Sp. Gr. 3·08 — 4·06. H. = 5·05 — 6·0.

Its color is brown, or brownish-black; sometimes dull externally, but the crystals have often a metallic, and sometimes a velvety lustre; they are opake. Primary form a Right rhombic prism of 111° 30′. It occurs amorphous, acicular, and also crystallized, generally in the form of a rhombic prism terminated by a pyramid with several modifications; cleavage not very distinct, parallel to a plane passing through its longer diagonal. Streak black, inclining to green or brown; fracture uneven; the faces of the prism deeply striated longitudinally. On charcoal it fuses into a black globule, which attracts the magnet if not heated to redness; and with borax melts readily into a dark green and almost opake glass. It is soluble in, and forms a jelly with, heated muriatic acid.

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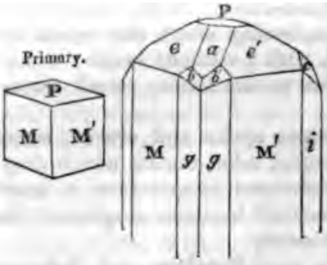
* Lievrite, in honor of Le Lievre, its discoverer; Yenite, in commemoration of the battle of Jena. † By Descotils. ‡ By Stromeyer.



M on M′	111°	30′
P on M or M′	90	00
M on g or M′ on g	164	35
M on *i*	160	48
g on g	151	42
M on *e* or M′ on *e*′	128	50
P on *e* or *e*′	141	48
e on *e*′	139	30
a on *e*′ or *e*	160	30
P on *a*	146	30
P on *c*	137	45
c on *e*′	144	25
b on *e* or *b*′ on *e*′	161	20

It is principally found in Elba, at Rio la Marina, and Cape Calmite, where it occurs both in solitary crystals of considerable dimension, and in groups which are also large and splendid. It was formerly quite abundant, but at present good crystals are rarely met with, and the prices demanded for them are very extravagant. One specimen at Porto Ferrajo is valued at three hundred dollars. It has also been noticed in Siberia; Silesia; and at Fossum in Norway. In Hungary, near the village of Szurnasko, Zemesker, it occurs in compact easily divisible masses of a black and greenish color, and when exposed to the weather, brownish.*

In the United States it was formerly obtained in Cumberland, R. I., in long, slender slightly rhomboidal prisms, longitudinally striated, and sometimes presenting the terminal faces. These prisms are implanted on granular quartz with minute octahedral crystals of magnetic iron ore. But of late years no specimens have been found at this locality.

PITCHY IRON-ORE.†

Eisensinter. Eisenpecherz, W. Fer Oxydé Resinite, H. Pittizite, *Levy*. Sideritine, *Beudant*.

	Saxony.	Freyberg.	
Peroxide of iron	33·46	40·45	35·0
Arsenic acid	26·06	30·25	20·0
Sulphuric acid	10·75	0·00	14·0
Protoxide of manganese	0·57	0·00	0·0
Water	28·48	28·50	30·0
	99·31 Stromeyer.	99·20 Kersten.	99·0 Laugier.

There is a great variation in these analyses, and the result obtained by Kersten, would seem to show that sulphuric acid is not essential to its composition. Future analyses must determine its true formula.

Sp. Gr. 2·2—2·4. H. = 2·5.

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* Berzelius' Jahres-Bericht, 1835, p. 223.

† From its more or less perfect resemblance to pitch.

Color blackish-brown, or reddish-black. It occurs in small masses, reniform, and stalactitic, having much the aspect of resin; fracture flat conchoidal, with a vitreous lustre; translucent on the edges, and yields to the knife; streak olive-green or lemon-yellow.

B B, *per se*, it instantly becomes opake and cracks, some varieties emitting a strong arsenical odor, during which they are partly volatilized; at an increased temperature it fuses into a black enamel, and on charcoal becomes magnetic; in the matrass it gives off water profusely.

It occurs in several old mines near Freyberg and Schneeberg in Saxony, in the district of Pless in Upper Silesia, in Brittany, and in Chili. It is supposed to be produced from the decomposition of iron pyrites.

PYROSMALITE.*

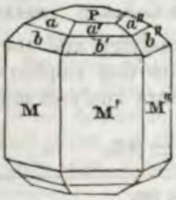
Pyrosmalyth, *Karsten.* Fer Muriaté, H. Pyrosmalite, or Native Muriate of Iron, J. Pyroxène Ferro-Manganesien, *Beudant.* Arealus rhombohedrus, D.

Contains	Silica	35·850
	Chlorine	3·760
	Peroxide of iron	35·480
	Sesquioxide of manganese	23·444
	Lime	1·210
	Water	3·600
		103·344 Hisinger.

The excess is owing to the additional oxidation of the iron and manganese which exist in the mineral as protoxides. Beudant does not regard the chloride of iron as essential, nor is it included in the chemical formula thus given by Rammelsberg: $4(\dot{F}e^3\dddot{S}i+\dot{M}n^3\dddot{S}i^2)$.

Sp. Gr. 2·95 to 3·10. H. = 4·0 — 4·5.

It occurs in the primary form, a regular hexahedral prism, of which the terminal edges are sometimes replaced, as represented on the following figure, copied with the measurements, from a short article by Brooke on the crystalline form of this mineral hitherto undescribed, inserted in the *Lond. and Edinb. Phil. Mag. for* 1837.



P on a	148°	30′
P on b	129	13
P on M	90	00
M on M	120	00

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* Pyrosmalite, or Pyrodmalite, from the Greek πυς, *fire*, and οδμη, *smell*, — emitting an odor when heated.

Cleavage distinct and easily obtained perpendicular to the axis. Color, pale-liver brown passing into gray and pistachio-green. External lustre shining, that of the terminal planes pearly; structure lamellar, translucent on the edges, and brittle. On charcoal B B, with a gentle heat, it becomes reddish brown, and gives out a weak acid odor; in a strong fire it fuses readily into a globule presenting a brilliant smooth surface and iron-black color, which is attractable by the magnet. With glass of borax it melts readily, exhibiting the colors characteristic of iron; and is soluble in muriatic acid, leaving a small residuum of silica.

It occurs, both crystallized and massive, with magnetic iron, calcareous spar, and hornblende, in Bjelke Gruvan, one of the iron mines of Nordmark near Philipstadt in Sweden.

SPATHOSE IRON.

Carbonate of Iron. Brown Spar.* Sparry Iron. Brachytypous Parachrose Baryte, M. Spath-Eisenstein, W. Fer Oxydé Carbonaté, H. Fer Spathique, Br. Clay iron stone, or Argillaceous iron ore. Marantalus rhombohedrus, D.

Combination of carbonic acid, and protoxide of iron, of which occasionally a small portion is replaced by protoxide of manganese, magnesia, and lime.

	England. *six-sided prisms.*	Baigony. *lamellar.*	*Sphærosiderite.*	Hartz.
Protoxide of iron	59·97	53·0	52·12	57·50
Carbonic acid	38·72	41·0	32·23	36·00
Oxide of manganese	0·39	0·6	0·00	3·30
Lime	0·92	0·0	0·00	1·25
Magnesia	0·00	5·4	9·96	0·00
Alumina	0·00	0·0	5·67	0·00
	100·00 Beudant.	100·0 Berthier.	99·98 Bischoff.	98·05 Klaproth.

The crystallized specimens of this mineral consist of pure carbonate of iron, composed of one atom carbonic acid and one atom protoxide of iron — $\underline{F}\dot{C}$ — but it is almost always mixed with various accidental substances. Beudant's analysis gives almost exactly the theoretical numbers required by the formula.

Sp. Gr. 3·6 — 3·8. H. = 3·5 — 4·5.

Color various shades of yellow, passing on exposure into brown, and brownish-black; transparent, translucent, or opake. Occurs in obtuse rhomboids (whose faces are occasionally curvilinear); in acute rhomboids, sometimes perfect, or having the terminal angles replaced; in six-sided prisms; in octahedrons; and in lenticular crystals; also striated and massive.

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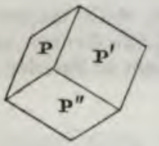
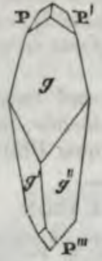
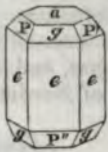
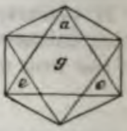
* Spathose Iron, from its presenting rather a sparry than a metallic substance; brown spar, from its prevailing color.

Externally it is shining. Structure lamellar, with a brilliant or pearly lustre; yields readily to cleavage parallel to all the planes of an obtuse rhomboid of 107° and 73°. Affects the magnetic needle. B B, blackens and becomes more magnetic, but does not melt; colors borax bottle-green in the reducing flame, and yellow in the oxidating; and is with difficulty soluble in acids, unless previously reduced to powder.









P on P'	107°	00′	P or P' on a (fig. 3)	140°	00′	c. g.
P or P' on P''	73	00	g on a (fig. 3) . . .	155	00	—
P or P' on g (fig. 2) . . .	122	50	a on g or g on e (fig. 4) . . .	107	00	—
g' on g'' (fig. 2)	67	20				

It occurs abundantly in some countries, and particularly in Styria and Carinthia, where it forms coherent tracts, which extend along the chain of the Alps into Austria and Saltzburg. On these the great iron manufactories of Eisenerz and Vordernberg are situated, so celebrated for the fine steel they produce. Magnificent crystals of spathose-iron occur at Harzgerode in the Hartz, in veins traversing grauwacke; at Freyberg in silver veins; and presenting many interesting varieties in the mining districts of Alston-Moor, Cornwall, and Devonshire.

In the United States carbonate of iron sometimes crystallized, or in readily cleavable masses of a reddish-brown color, and of a brilliant lustre, forms a considerable bed in mica slate at Sterling, Mass. It occurs also very abundantly in gneiss at Roxbury, Conn., where it is of a yellowish-grey color, and is associated with iron and copper pyrites. Very beautiful specimens have been brought from Plymouth, Vt.

Junkerite. M. Dufrenoy* has discovered at Poullaouen in Brittany, a carbonate of protoxide of iron which crystallizes in right rhombic prisms and rectangular octahedrons, thus showing carbonate of iron to be dimorphous like several other minerals. It agrees very nearly in composition with the analyses just given, and its general physical characters identify it with common spathose iron. Its name is in honor of Mr. Junker, the sub-director of the mine where it was discovered.

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* Ann. de Chim. et de Phys. lvi. 198.

A **Fibrous Carbonate of Iron** occurs in the veins of Tin Croft mine in Cornwall, in tabular masses of half an inch or less in thickness, striated in a direction perpendicular to the surfaces of the mass, and of a brown color. *Sphærosiderite* is the name applied to a spheroidal and radiated variety from Hanau, where it is met with occupying hollows in greenstone without any indication of crystalline form.

Columnar Clay Iron-stone. Its colors are the same as the amorphous. It occurs in angular pieces composed of columnar concretions like starch, often closely aggregated, and cohering slightly; or the interior is found to be columnar, the interstices being in some cases filled either with bitumen or calcareous spar. It is dull, soft, brittle, and when of a reddish-brown color is magnetic. It occurs in Bohemia, the Upper Palatinate, and Saarbruck; in Scotland in the Isle of Arran; in England in the Wednesbury coal deposit in Staffordshire, where the columns are coated with pyrites, and their interstices partially filled with carbonate of lime, sometimes with blende and galena.

Lenticular Clay Iron-stone. Fer oxydé brun granuleux, Bt. It occurs in small granular or lenticular concretions, which are separate or aggregated into masses. Its color is reddish, or yellowish-brown, or greyish-black, with a pseudo-metallic lustre. Is brittle, and easily broken. It occurs in Franconia, Bavaria, Salzburg, Switzerland, France, and the Netherlands.

Clay Iron Stone, or Argillaceous Carbonate of Iron. This is the variety which occurs so extensively in the coal formations of Great Britain, and supplies nearly all of the iron which is made there. Dr. H. Colquhoun published in the seventh volume of *Brewster's Journal* his analyses of about twenty specimens of the Scotch clay iron stones, in which he finds from fifty-five to sixty per cent. of carbonate of iron, the rest being carbonate of lime and magnesia, with clay. The "black band" of Mushet contains eighty-five per cent. of carbonate of iron, or forty per cent. of metallic iron, and is the richest of the ores accompanying the coal formations in Great Britain. The ores which are found in the anthracite and bituminous coal measures of Pennsylvania, and those which occur so plentifully in the neighborhood of Baltimore, Md., have very nearly the same composition with the above, and yield from twenty to forty-five per cent. when reduced in the smelting furnaces.

PHOSPHATE OF IRON.

Vivianite, W. Fer Phosphaté, H. Blue Iron Ore, J. Prismatic Iron Mica, M. Dicromatic Euclas-Haloide, *Haidinger*. Arealus rhomboideus, D.

Combination of phosphoric acid, protoxide of iron, and water.

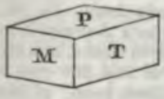
	Cornwall.	Bodenmais.	*Earthy Phosphate.*	New Jersey.
Protoxide of iron	41·23	41·0	32·0	44·51
Phosphoric acid	31·18	26·4	47·5	25·85
Water	27·49	31·0	20·0	28·26
	99·90 Stromeyer.	98·4 Vogel.	99·5 Klaproth.	98·62 Vanuxem.

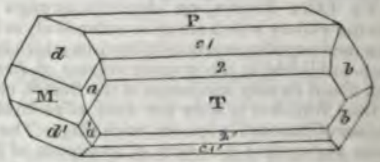
These results differ widely from each other. Dr. Thomson has thus given a formula from the first analysis by Stromeyer: $F^{1\frac{1}{2}}\dot{P}h+3\frac{1}{3}Aq.$

Sp. Gr. 2·66. H. = 2·0.

Vivianite occurs crystallized in the form of a Right oblique-angled prism, which is that of its primary crystal. It cleaves readily, and only parallel to the plane P of the following figures; the crystals are prismatic, and of considerable length, being attached to the matrix at the face M or the opposite plane, in which case the faces P T and *c* form the prismatic planes of the crystal. Color varying from pale green to indigo-blue; by transmitted light green at right angles to the axis, and of a pale blue color parallel to it. Transparent or translucent, with a partly metallic, partly vitreous lustre; streak almost white, but on exposure to the air soon changes into indigo-blue. The powder produced by crushing the mineral in a dry state, is liver-brown. The crystals are often very small, aggregated, and divergent; those of Cornwall are flexible, but not elastic, while the crystallized variety of New Jersey is extremely brittle. B B, on charcoal it intumesces, reddens, and fuses into a steel-grey colored globule with metallic lustre. Soluble without effervescence in dilute sulphuric and nitric acids.

Primary.





P on M or T	90°	00′	M on *d* or *d*′	150°	30′
M on T	125	18	*b* on *b*	148	5
P on *c*1	125	56	*c*1 on *a*	140	35
—— *d*	135	35	—— *d*	134	5
T on *c*1	143	40	—— *b*	125	40
—— *c*2	165	25	—— *c*1	108	30
—— *b* or *b*	125	25	—— *c*2	157	45
M on *c*1	117	40	*d* on *d*′	120	45

It occurs with iron- and magnetic-pyrites in gneiss at Bodenmais in Bavaria; in the gold mines of Vöroöspatak in Transylvania; in the Isle of France; and in Brazil.

In England it is met with finely crystallized near St. Agnes in Cornwall, accompanied by magnetic iron-pyrites and spathose iron; in Derbyshire in crystals of the same form and color, in the decomposed shale of that country.

In the United States it occurs crystallized and in nodules, imbedded in bog iron ore at Allentown, Monmouth county, N. J., and occupying the interior of belemnites and gryphites, in the ferruginous sand formation in the same region. It has been found here in masses weighing thirty pounds.

Delvauxine. M. Dumont (*L'Institut*, 1839, No. 282,) has given this name, in honor of M. Delvaux, to a phosphate of iron which he had discovered in a lead mine, and a chalk quarry at Bernean near Visó, in France. It forms kidney shaped masses, which easily separate with a conchoidal fracture and resinous lustre. It is a little harder than gypsum, and falls to pieces when moistened with water. Specific gravity 1·85. Its analysis gave M. Dumont, phosphoric acid 13·6, protoxide of iron 29·0, water 40·20, besides 11·0 carbonate of lime and 3·5 silica, which are accidental. Berzelius observes that this is the same basic phosphate as that from the Isle of France, with the difference that it contains twice the amount of water.

Anglarite of Kobell. This is a fibrous and compact variety of phosphate of iron. Its color is grey, inclining to blue; and it is translucent. B B, it melts into a black globule, and in the matrass yields water.

It occurs at Anglar, in the Haute Vienne, France.

Mullicite of Dr. Thomson. This is from Mullica Hill, Gloucester county, N. J., and has been made into a new species by Dr. Thomson. Its analysis gave phosphoric acid 24, protoxide of iron 42·65, water 25, sand 7·90. It forms very brilliant radiating needle-form crystals, attached to casts of several of the fossils of the green sand formation.

Yellow Phosphate of Iron, containing **Chlorine**. — *C. T. Jackson.* This variety occurs in compact, botryoidal masses, in the primary rocks of Newfield, Me. Color brownish or greenish-yellow; lustre on fractured surfaces resinous. Streak and powder nearly white. Hardness 5. B B, on charcoal turns black the moment the flame acts upon it, and becomes magnetic; fuses slightly on the edges into a black glass; with soda into a yellow bead. In a glass tube, with charcoal, yellow scales sublime which are *chloride of iron*. The presence of chlorine is also shown by the usual acid tests. Dr. Jackson obtained protoxide of iron 64·394, phosphoric and chlorohydric acids 56·606.

Earthy Phosphate of Iron. Blaue Eisenerde, W. Fer phosphaté terreux, H. Blue Iron Earth, J. The color of this variety on its first exposure is grey, yellow, or greenish-white, or with a very slight tinge of blue; afterwards it becomes blue of different degrees of intensity. It occurs massive, disseminated in or coating other substances; and is sometimes loose, occasionally cohering, and with an earthy fracture. It is dull, meagre to the touch, soils the fingers slightly, and is light. B B, it becomes reddish-brown, and then melts into a brownish-black slag, attractable by the magnet. It occurs in clay, and mud, more or less intermingled with animal matter, from which the phosphoric acid is conjectured to have proceeded. Also in argillaceous deposits in many places where it seems to have had its origin from the decomposition of animal substances. It has been brought from Styria, Carinthia, and Greenland. The friable varieties have been met with in forming excavations in the river mud of the Isle of Dogs; in the same deposit at Toxteth near Liverpool. On the surface of peat-mosses in several of the Shetland Isles; at Ballagh in the Isle of Man, accompanying animal matter, as the bones of the elk and deer.

Bog iron ores are frequently more or less contaminated with phosphate of iron, and the cold short quality of the cast iron obtained from them, has been supposed to be owing either to the direct combination of phosphoric acid with the metal, in the process of smelting, or to its not leaving the iron with which it was already united in the ore. It is evident, however, that phosphoric acid could not escape decomposition in the intense heat of the smelting furnace.

HETEPOSITE.

Kobell. (*Ann. de Chim.* xxx. 294.) Hétérosite, B. Marantalus Frenœi, D.

Consists of phosphoric acid 41·77, protoxide of iron 34·89, protoxide of manganese 17·57, silica 0·22, water 4·40.—*Dufrésnoy.* Formula: $2\underline{F}Ph^2+\underline{M}nPh^2+Aq$.

Massive; having a lamellar structure, and a greenish-grey or blue color; lustre resinous, like that of apatite. Primary form an Oblique rhombic prism of 100° and 80°, and 101° and 79°, obtained by cleavage. After long exposure to the atmosphere its color becomes violet, and its lustre is changed into semi-metallic. Is soluble in acids, with the exception of its silica; and B B, fuses into a brown enamel, which has a semi-metallic lustre.

It occurs at Hureaux, in the Haute Vienne, and was noticed and described by M. Dufrésnoy.

KARPHOSIDERITE.

Breithaupt. (*Brewster's Journal*, viii. 181.)

Consists of phosphoric acid, oxide of iron, and water.

Sp. Gr. 2·5. H. = 4·0 — 4·5.

Occurs in reniform masses of a straw-yellow color; lustre resinous; fracture uneven; feels greasy. B B, in the open tube, it gives off water, accompanied by fumes which redden turmeric paper; alone on charcoal it becomes black; and at a high temperature melts into a globule, which is powerfully magnetic. Is soluble with facility in borax, and with salt of phosphorus forms a black scoria.

This mineral was distinguished by Breithaupt, who named it in allusion to its straw-yellow color. Its locality is Labrador.

SULPHATE OF IRON.

Green Vitriol. Melantérie, *Beudant.* Eisen-Vitriol, W. Fer Sulphaté, H. Hemi-Prismatic Vitriol, J. Hemi-Prismatic Vitriol Salt, M. Vitriolum Martiale, D.

Composed, by the analysis of Berzelius, of sulphuric acid 28·8, protoxide of iron 25·7, water 45·4. Formula: $\underline{F}\dot{S}l+6Aq$.

Sp. Gr. 1·84 — 1·9. H. = 2·0.

Primary form an Oblique rhombic prism. M on M′ = 82° 20′, P on M or M′ 99° 20′. It is usually modified by replacements on the acute and obtuse solid angles, as well as on the acute and obtuse terminal edges; sometimes also on the lateral edges. (See fig. 12, p. xi. of the *Introduction.*)

It presents various shades of green, sometimes emerald-green; but more frequently, owing to exposure, is externally of a yellow or yellowish-brown color. It occurs in crystals, also massive, pulverulent, and in stalactites; cleavage perfect parallel to P, less so to M; translucent; lustre vitreous; taste extremely astringent; fracture conchoidal. It is readily soluble in double its weight of water, and the solution turns black on the addition of tincture of galls. B B, on charcoal it becomes magnetic, and colors glass of borax green. Exposed to the air, it soon appears covered with a yellow powder, which is the persulphate of iron.

It occurs in the Rammelsberg mine near Goslar in the Hartz, at Schwartzenberg in Saxony, and at Schemnitz in Hungary; also in aluminous shale, at Hurlet near Paisley; and in New England, where it forms crusts upon the surfaces of such mica-slate rocks as happen to abound in iron pyrites.

This species in its natural state is rare; in most cases it is produced by the decomposition of other minerals, particularly iron pyrites, when it is freely exposed to the action of air and moisture, by which the sulphur is changed in sulphuric acid, the iron into an oxide, and a combination thus takes place between them with the addition of water. It is sometimes found dissolved in the waters of certain mines. This natural copperas is used in dyeing, in making ink, Prussian blue, and sulphuric acid.

WHITE COPPERAS. COQUIMBITE.

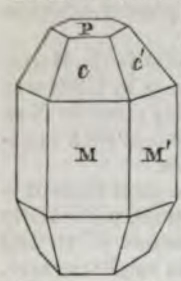
Bisulphated Peroxide of Iron, *Thomson*. (*Outlines*, &c., i. 450.) Vitriolum hexagonum, D.

The results of three analyses of this mineral are as follow:

Sulphuric acid	43·55	43·55	41·369
Peroxide of iron	24·11	25·21	26·789
Alumina	0·92	0·78	1·050
Lime	0·73	0·14	0·000
Magnesia	0·32	0·21	0·300
Silica	0·31	0·37	0·825
Water	30·10	29·98	29·397
	100·04 H. Rose.	100·24 H. Rose.	99·680 J. H. Blake.

Dr. Thomson has deduced the atomic composition of this mineral from the first analysis. By supposing the alumina, lime, and magnesia, to be united with sulphuric acid, he obtains very nearly two atoms of sulphuric acid to one of peroxide of iron, combined with five atoms water of crystallization. Formula: $\underset{\cdot}{F}\dot{S}l^2+5Aq$. But Rammelsberg has described this salt as a *ter sulphate*, and even shown by the method of determining the ratios of the constituents from the quantities of oxygen contained in them, that there is a small quantity of free sulphuric acid present in this mineral. In the analysis by Mr. Blake there is a deficiency of acid, while the iron and water answer more nearly the demands of the formula, as given by Rammelsberg, than either of the other two.

The salt is white, also of various shades of brown, yellow, red, and sometimes even of a deep blue violet color. It is in masses of a granular texture, some parts of which are crystallized. The crystals are in regular hexahedral prisms, terminated at both extremities by six-sided pyramids. The faces of the pyramids c c' meet each other at an angle of 128° 8′, and incline upon the faces M M′ at an angle of 119°. P on c or c' 151°. Cleavage imperfect parallel with M. The crystals are entirely soluble in water, and if the solution be heated, a copious precipitate of peroxide of iron falls. When dissolved in water containing muriatic acid, a portion of silica remains undissolved. According to Prof. G. Rose, the solution after long standing in the air yields crystals which do not seem to have the form of the natural salt.



It would seem probable that this is a dimorphous salt, as the specimens obtained by Mr. Blake, who has carefully explored the region in which it is found, present regular octahedral crystals of considerable size, as well as perfect hexahedral prisms, the only form observed by Rose. These octahedrons are obtained more beautiful and perfect by re-dissolving the salt in pure water and subsequent crystallization. It was one of the natural octahedral crystals which Mr. Blake analyzed.

This salt is found in great abundance in the extreme southern part of Peru — the western part of Bolivia, near Calama, and in the northern part of Chili, near Copiapo, forming beds and veins in feldspar porphyry or trachyte in the outer and western range of the Andes. About five leagues east of the town of Copiapo there is an extensive bed five or six yards in depth, and in Bolivia it occurs in extensive veins traversing feldspar porphyry. Near Calama it constitutes the greater part of a large hill.

SULPHATED PEROXIDE OF IRON.

Dr. Thomson. (*Outlines*, &c., i. 451.)

This salt is found encrusting the preceding, in small grains or six-sided tables, and accompanying masses of a dirty yellowish-green matter which is not crystallized. When separated from this, its analysis, by H. Rose, gave the following results: sulphuric acid 31·73, peroxide of iron 28·11, lime 1·91, magnesia 0·59, water 36·56, silica 1·43.

The sulphuric acid amounts to 6·33 atoms, and the peroxide of iron to 5·62; but the lime and magnesia amount together to 0·75 atom, which supposing them to be united with sulphuric acid, leave 5·58 atoms of sulphuric acid to combine with 5·62 atoms peroxide of iron — numbers so nearly equal that it is evident the salt is a neutral sulphated peroxide. The water amounts to nearly 6 atoms. Formula: $F\dot{S}l+6Aq$. The color of this salt is yellow; it is translucent; and possesses a pearly lustre. It is mixed with a good deal of silicious matter which is not easily separated. Cleaves readily parallel to P of the tables.

BOTRYOGENE.

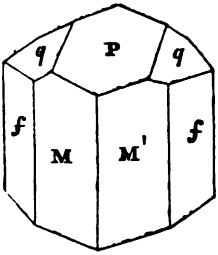
Native Red Iron Vitriol of Fahlun, *Haidinger.* Rother Eisen-Vitriol, *Leonhard.* Neoplase, [illegible] *Beudant.* Vitriolum bicolor, D.

Consists of sulphuric acid 32·55, peroxide of iron 23·86, protoxide of iron 10·71, water 32·85.

Formula, by Beudant, $\underline{F}\dot{S}l^2+3\underset{.}{F}\dot{S}l+12Aq$.

Sp. Gr. 2·039. H. = 2·25 — 2·5.

Primary form an Oblique rhombic prism of 119° 66′ and 60° 4′.



M on M′	119°	56′
f on *f*	81	44
q on *q*	141	0

Occurs in small crystals which are usually aggregated in reniform and botryoidal masses, consisting of globules with a crystalline surface; sometimes like a bunch of grapes, hence its name, from βοτρυς. Faces of *f* and M striated parallel to the axis, and less perfectly formed than the inclined planes; cleavage parallel to M. Color deep hyacinth-red, passing, when massive, into ochre-yellow, the color of its streak; translucent; lustre vitreous; taste slightly astringent. When exposed to a moist atmosphere it becomes covered with a dirty yellow powder, but remains unchanged when dry. B B, it intumesces and gives off water, leaving a reddish-yellow earth; with salt of phosphorus yields a red glass, which becomes colorless on cooling. Boiling water dissolves only a part of it. It occurs in the great copper mine of Fahlun in Sweden, in the level called Mellanrumsort, forming a coating on gypsum or pyrites, along with Epsom salt, green vitriol, &c. — *Allan's Manual.*

The Misy of Hausmann occurs with, and is nearly related to this species. As no analysis is given of it by Rammelsberg its composition is not accurately known. The name Misy was first given by Pliny to some artificial compound obtained in the process of making vitriol in the Island of Cyprus.

ARSENIATE OF IRON.

Wurfelerz, W. Fer Arseniaté, H. Cube-Ore, J. Pharmakosiderit, *Haus.* Hexahedral Lirocone Malachite, M. Arealus cubicus, D.

Combination of arsenic acid, protoxide and peroxide of iron, and water, mixed with phosphoric acid and oxide of copper in very minute proportions.

Peroxide of iron	39·20	40·56	45·5
Arsenic acid	37·82	38·00	31·0
Phosphoric acid	2·53	0·70	0·0
Oxide of copper	0·65	0·60	9·0
Water	18·61	19·57	10·5
Insoluble matter	1·76	0·35	4·0
	100·57 Berzelius.	99·78 Berzelius.	100·0 Chenevix.

The two analyses by Berzelius give very nearly one atom arsenic acid, one atom peroxide of iron, and three and a half atoms water, so that the mineral appears to be a hydrous subsesquiarseniate of iron. Formula: $F^{1\frac{1}{2}}\dot{A}s+3\frac{1}{2}Aq.$

Sp. Gr. 2·9—3·0. H. = 2·5.

Various shades between light- and bottle-green, and yellowish- and brownish-green; it rarely occurs massive, mostly crystallized in its primary form, a Cube, either perfect or having the alternate angles replaced by one or by three planes, very rarely with all the edges and angles replaced. The small planes *b*, *b*, on the largest of the following figures, appear at first only as striæ, apparently indicating the tetrahedron as the primary form; but the crystals yield to cleavage parallel to the planes of the cube, though not with sufficient brilliancy for the use of the reflective goniometer. The cross fracture is uneven or imperfectly conchoidal, with a shining vitreous lustre. It varies from transparent to opake; sometimes ochreous externally, from partial decomposition; and is brittle. Streak pale olive-green. B B, on charcoal it emits arsenical vapors, and fuses into a grey scoria which exhibits metallic brilliancy and is attractable by the magnet. With the fluxes, after the disengagement of arsenical fumes, it forms bottle-green colored globules. On exposure to heat it becomes electric, and is soluble in concentrated acid.

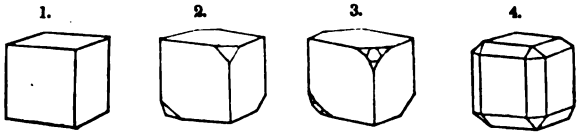
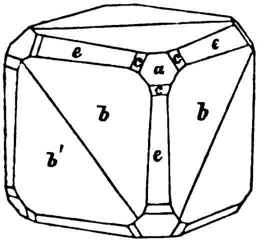


Fig. 1, the cube. Fig. 2, the same, of which the alternate solid angles are replaced by triangular planes. Fig. 3, in which they are replaced by four planes; these are sometimes rounded, and appear but as one plane. Fig. 4, the cube, of which both the edges and angles are replaced.



b on *b* or *b*	93°	40′
b on *b′*	176	30
b (upper) on *b′*	86	30

the other planes are dull, or somewhat convex.

Its principal localities are the mines of Huel Gorland, Huel Unity, and Carharack in Cornwall, where it occurs associated with various ores of copper. On the continent it has been found at St. Leonard in France, and at Schneeberg and Schwartzenberg in Saxony, but it is a rare mineral out of England.

DIARSENIATE OF IRON.

Dr. Thomson. (*Outlines, &c.*, i. 456.)

This mineral is composed, by the analysis of Kersten, of arsenic acid 30·25, peroxide of iron 40·45, water and a trace of sulphuric acid 28·50. The numbers correspond with one atom arsenic acid, two atoms peroxide of iron, and six atoms water. It is therefore a hydrous arseniate of iron, as thus expressed by the formula — $\underset{\cdot}{F}^2\bar{A}s+6Aq$.

It occurs in yellowish-grey kidney-shaped pieces, soft, approaching to friable, with a coarse earthy fracture, and adhering strongly to the tongue. Without lustre, and rough to the feel. It was first noticed by Freiesleben, in the neighborhood of Freiberg, but it does not appear to have been observed under any crystalline form.

ARSENIATE OF IRON.

This mineral has been analyzed by Berzelius and Boussingault, giving the following results:

Arsenic acid	50·78	49·6
Peroxide of iron	34·85	34·3
Oxide of lead	0·00	0·4
Arseniate of alumina	0·67	0·0
Water	15·55	16·9
	101·85 Berzelius.	101·2 Boussingault.

Dividing the mean numbers which these two analyses give, by the atomic weights, we obtain one atom arsenic acid, one atom peroxide of iron, and two atoms water. But one third of the iron is supposed to be in the state of protoxide, whence Dr. Thomson has given this formula; $\underline{F}\dot{A}s+2\underset{\cdot}{F}\dot{A}s+6Aq$.

It occurs massive; usually in small porous masses, presenting imperfect crystallizations, among which Berzelius observed Right square prisms terminated by four-sided pyramids. Color pale; streak white. Heated in a glass tube it gives out water with the evolution of arsenious acid. B B, it becomes yellow, but without changing its form.

This mineral occurs at Antonio Pareiza, Villa Rica, in Brazil, and at Loaysa, near Marmato, in Popayan.

OXALATE OF IRON.

Fer Oxalaté, *Levy*. Oxalate de Fer. Humboldtine, *Rivero*. Humboldtite, *Necker* and *Beudant*. Astasialus phytogeneus, D.

Combination of oxalic acid, protoxide of iron, and water.

Oxalic acid	46·14	42·40
Protoxide of iron	53·86	41·31
Water	0·00	16·47
	100·00 Rivero.	100·00 Rammelsberg.

Since the oxygen of the oxalic acid, of the protoxide of iron, and of the water, is as 3 : 1 : 1, 5, humboldite is a neutral oxalate of the protoxide of iron, with one and a half atom of water. It thus differs from the artificial combination by containing one half atom less of water.* Formula: $\underline{F}\dot{O}+1\frac{1}{2}Aq$. or, as stated by Rammelsberg, $2\dot{F}e\ddot{\bar{C}}3\dot{\bar{H}}$. Rivero's number gave very nearly one atom acid to one atom base, but it appears that he overlooked the water.

Sp. Gr. 2·13 (Leonhard), 1·3 (Beudant). H. about 2·0.

It occurs in small flattish masses of a bright yellow color, and crystalline, but the crystals are not determinable; opake, devoid of lustre, and having an uneven earthy fracture. It acquires resinous electricity by friction; it decomposes easily on live coal, giving out a vegetable odor, the residue passing by degrees from yellow to black, and finally to red. It is insoluble in boiling water and alcohol, but dissolves without effervescence in nitric acid, imparting to it a yellowish tint.

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* Rammelsberg's Handwörterbuch, part 1st, p. 315.

It is found at Koloseruk, near Bilin in Bohemia, imbedded in moor-coal or friable lignite, and is supposed by its analyst to result from the decomposition of succulent plants.

Dr. Thomson, from an examination of this mineral, has been led to question whether oxalic acid is really contained in it, but Rammelsberg's result renders it probable that he did not receive a genuine specimen of the substance.

TUNGSTATE OF IRON.

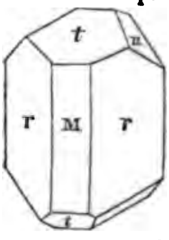
Wolfram, W. Scheelin Ferruginé, H. Bt. Prismatic Wolfram, J. Prismatic Scheelium Ore, M. Wolframius rectangulus, D.

Combination of the oxides of tungsten, iron, and manganese.

	Cumberland.	Haute-Vienne.	Bohemia.	Cumberland.
Tungstic acid	74·666	73·511	73·60	78·77
Protoxide of iron	17·594	20·745	11·20	18·32
Prot. of manganese	5·640	5 744	15·75	6·22
Silica	2·100	0·000	0·00	1·25
	100·000 Berzelius.	100·000 Vauquelin.	100·55 Richardson	104·56 Berz.

We obtain from the two analyses by Berzelius, numbers which approach very nearly to three atoms tungstate of iron, and one atom tungstate of manganese, or $3\underline{\mathrm{F}}\dot{\mathrm{T}}\mathrm{n}+\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{T}}\mathrm{n}$.

Sp. Gr. 7·11 — 7·33. H. = 5·0 — 5·5.



Color brownish-black; is found both massive and crystallized in rectangular prisms. Structure lamellar; cleavage perfect parallel to a plane which bevels the lateral edge between *r* and *r*; streak dark reddish-brown; lustre brilliant, often metallic; opake; and is brittle; — *t* on *t* over the apex, 125° 20′; *r* on *r* over M, 101° 5′. B B, it decrepitates, and fuses under a strong heat into a black and somewhat scoriaceous globule; it is readily soluble in borax, and does not act on the magnet.

Wolfram is peculiar to primitive rocks; and is a common associate of tin ore, particularly in the mines of Saxony, Bohemia, and Cornwall. In the former countries it is found in large well-defined crystals; in the latter in such abundance as frequently to impede the working of the tin ore. At Wheal Maudlin in Cornwall it has occurred in pseudomorphous crystals, assuming the precise form of tungsten. Greenland, Siberia, Limoges in France, and the island of Rona in the Hebrides, are other localities of this species.

In the United States, this mineral is found in considerable quantity at Lanes mine, Monroe, Conn., in an extensive bed of quartz, accompanied by tungsten, blende, galena, and native bismuth. It occurs under similar circumstances in quartz at Trumbull in the same State. In Maine, at Bluehill, with sulphuret of molybdena, and at Jackson, N. H., accompanying the veins of oxide of tin, discovered by Dr. Jackson. This mineral is frequently pseudomorphic, or takes the form of other substances, as of carbonate of lime, felspar, and tungstate of lime. (See the table of pseudomorphous bodies, p. lxxxii. of the *Introduction.*)

RUTILE.

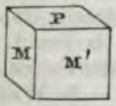
Prismatico-Pyramidal Titanium-Ore, J. Peritomous Titanium Ore, M. Rutil, W. Titane Oxydé, H. Rutile, Br. Red Oxide of Titanium, *Cleaveland.* Titane Rutile, Bt. Titanic acid, *Thomson.* Rutilus quadratus, D.

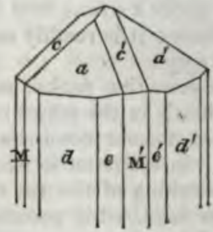
This species consists of titanic acid united with various proportions of oxide of iron. Formula: $\dot{T}t$.*

Sp. Gr. 4·24—4·4. H.=6·0—6·5.

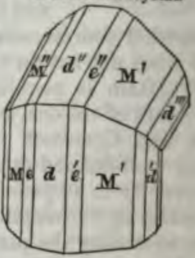
Usual color reddish-brown, in which case it is opake; also in prismatic crystals terminated by pyramids, of a blood-red color, and then translucent or transparent. It occurs in four- or eight-sided prisms, either single or geniculated, and commonly striated longitudinally; also in minute reticulated crystals. The structure is lamellar. The primary form is a Right square prism; cleavage perfect parallel to M, interrupted parallel to *d*; the fragments possess metallic adamantine lustre; cross fracture imperfectly conchoidal or uneven; streak very pale brown; brittle; acquires resinous electricity by friction. B B, it is infusible *per se*, but with borax it forms a transparent reddish-yellow glass, which, when long in the reducing flame, assumes an amethystine color.

Primary.





Geniculated crystal.



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[*] In the crystals of this mineral from St. Yrieix, Prof. G. Rose found only 1·53 per cent. peroxide of iron; whence we may suppose the above formula to represent the true composition of this species.

P on M or M′	90° 00′	*a* or *a*′ on *c*′	151° 42′
M on M′	90 00	*a* on *d* or *a*′ on *d*′	132 20
— on *d* or M′ on *d*′	135 5	*d* on *e*	153 33
M on *e* or *e*′	161 40	M on M″ or M′ on M″ (macle)	134 52
M on *c* or M on *c*′	122 45	*a* on *a* over summit	114° 30′ }*
a on *a*′	123 15	*c* on *c* over summit	128° 08 }*

Rutile is most frequently met with in lengthened prismatic crystals imbedded in quartz, as at Crianlarich in Perthshire, Rosenau in Hungary, Käringbricka in Sweden, Arendal, St. Gothard, and in Brazil. When the quartz is limpid, and is cut and polished to show the rutile, its slender needle-shaped, or hair-like crystals, appear of a blood-red hue by transmitted light. The reticulated variety occurs at St. Gothard, disposed in red, translucent flat prisms, on crystals of fer-oligiste. At St. Yrieix in France, Horcaejulo in Spain, and in Castile, it forms remarkable geniculated twin crystals, which are often of large size.

Nigrin,† W. Titane oxydé ferrifère, H. Titan nigrin, Bt. Oxide of titanium containing about 14 per cent. of iron. Of a brownish-black color, and generally in loose, angular, or rounded masses; structure lamellar; cross fracture flat and imperfectly conchoidal; lustre shining; streak pale-brown, and in most of its characters precisely similar to rutile. It is found in alluvium in Ceylon with iron sand, hyacinth, &c.; and at Ohlapian in Transylvania with gold, almandine, and rutile.

In the United States, the most delicately acicular, or hair-shaped crystallizations, have been found in loose masses of quartz, in the vicinity of Hanover, N. H. A specimen in the cabinet of Dartmouth College, will vie in beauty with any brought from Brazil. According to Dr. Jackson, it occurs massive, and forms considerable veins in the gneiss rocks of the Souhegan River, and Merrimack Mountain, N. H.; also crystallized, and sometimes in macled forms, in mica-slate, at Cornish, N. H. Very fine single crystals, with highly polished planes, occur in the chlorite slate of Windsor, Mass., and imbedded in the felspar which occupies the seams of the slate. Prof. Hitchcock has also found in the gneiss at Barre, large and perfectly formed prisms along with crystallized mica and sulphuret of iron. Large compound crystals, of a dark color,

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[*] The measurements of these angles were incorrectly given in the former editions of this treatise. The first (*a* on *a*′ over summit =90°), was so obvious that we are surprised to find it copied into other works unobserved. Mr. Brook and Prof. Miller, have referred to them, as one or two mistakes made by the author, probably in transcribing; and the last named gentleman, has now given the values of these angles, in an article on the forms of rutile, in the Lond. and Edinb. Phil. Mag., xvii. 268. Mr. Teschemacher at my request, had previously obtained the values of *a a*, as above stated, but the planes *c*, *c*, were not sufficiently perfect for measurement. I have therefore added, as above, Prof. Miller's determination of their values. His observed values of *a a*, almost exactly coincided with Mr. Teschemacher's. [Am. Ed.]

[†] From its black color.

are found at Munroe and Huntington, Ct. The white limestone of Essex and Warren counties, N. Y., as at Amity and Warwick, and of Kingsbridge, New York county, according to Drs. Beck and Horton, furnishes several forms of crystallized rutile; often in acicular four-sided semi-transparent prisms, of a dark blood-red color — these prisms being united at their bases, so as to form the *géniculé-ternaire* of Haüy.

It occurs at Edenville and Amity, N. Y., and is associated with pargasite at the former place, and with spinel, mica, &c. at the latter. It is contained also in the same limestone rock at Newton and Sparta, N. J., and accompanied by the various interesting minerals of this region. The white and grey quartz, which abounds in the vicinity of Georgetown, D. C., has lately added many beautiful crystals to the cabinets of American mineralogists, and the specimens are no less remarkable for their perfection, than for the magnitude of their crystals, many of them having their terminal planes complete, and measuring three inches in length. Crystals of equal dimensions, with highly lustrous planes, have been found at Sadsbury, Lancaster and Chester counties, Penn., about 40 miles west of Philadelphia. According to J. A. Clay, the finest geniculated crystals are found loose in the soil, and these sometimes measure five inches in length.

TITANIATE OF IRON.

Menakan. Menaccanite. Iserine. Gregorite.

Compound of titanic acid and oxide of iron.

	Menaccanite.	Iserine.		Brazil.
Titanic acid	57·187	50·12		41·0
Protoxide of iron	39·780	49·88	Peroxide	56·2
Protoxide of manganese	2.175	0·00	Quartz	2·5
	99·142 Colquhoun.*	100·00 H. Rose.		99·7 Berthier.

Sp. Gr. 4·5—5. H. = 5—5·5.

It occurs in small black granular masses, which slightly affect the magnetic needle, and were first noticed in the bed of a rivulet near Menaccan, in Cornwall; and near the rise of the stream Iser† in the Riesengebirge of Silesia. Also from Botany Bay, in New South Wales, and on the shores of Siecles in Brittany.

These ferro-titaniferous minerals vary considerably in their proportions of titanic acid and iron, and probably include more than one species. Regarding the mineral a compound of one atom titanic acid, and one atom protoxide of iron, the first analysis gives an excess of acid, and the second a deficiency. The third comes very near to a subsesquititanite of iron. But we shall omit the formula.

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* Thomson's Outlines, &c., i. p. 465.

† Whence Menaccanite and Iserine.

The Hystatite, or *hystatisches eisenerz* of Breithaupt, should probably come under this head, though in crystalline form it approaches nearer to Ilmenite. According to Von Kobell, it consists of titanic acid 43·24, protoxide of iron 27·91, peroxide of iron 28·66. Von Kobell's *Basanomelan*, and Breithaupt's *trappisches eisenerz*, seem to follow in the same class. The latter occurs in cubes and octahedrons.

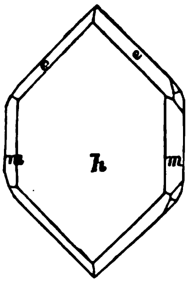
BROOKITE.*

Prismatic Titanium Ore, *Haidinger*. Brookite, *Levy*. (*Ann. of Phil., second series*, ix. 140.) Jurinite of Soret.

Contains titanic acid, with some traces of iron and manganese, but it has not been analyzed.

H. = 5·5 — 6·0.

Primary form a right rhombic prism of 100° and 80′. The measurements are, *e* on *e* 101° 37′, *e* on *e*′ (opposite side) 135° 46′, *m* on *m* over *h* 140°.



In crystals of a hair-brown color, passing into deep orange-yellow, more or less translucent; streak yellowish-white; lustre brilliant, metallic-adamantine. Insoluble and indecomposible in boiling muriatic acid, even when reduced to powder. Alone on charcoal it is infusible, but it is entirely soluble and forms a brownish-yellow glass with salt of phosphorus.

This species occurs in extremely beautiful crystals with anatase and Crichtonite at Bourg d'Oisans in Dauphiné, and was first noticed by M. Soret. It occurs also on the Tête-noire in Savoy, and in large distinct crystals, sometimes half an inch in diameter, at Tremadoc in Wales. It is, however, a rare mineral, and the locality is supposed to be exhausted. According to Joseph A. Clay, a single, but very perfect crystal, not distinguishable from Brookite, has been found at Phenixville, on the Reading rail-road, Penn., associated with pearl spar.

CRICHTONITE.†

Fer Oxydulé Titané, H. Crichtonite, *Bournon*. Sideros acrotomus, D.

Sp. Gr. 4·0. H. = 4·5.

It occurs in small crystals in the form of acute rhomboids, having the summits replaced, and being otherwise variously modified by secondary planes; the only cleavage is at right s to the axis of the rhomboid, *i. e.* parallel to the plane *a*. r bluish-black, opake, and of a brilliant metallic lustre; ross fracture conchoidal and shining; streak deep black. ible B B, but with salt of phosphorus affords a glass h becomes red on cooling. It does not affect the magnet. itonite is classed by Berzelius with menaccanite.

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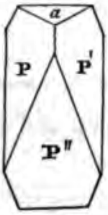
* In honor of H. J. Brooke, Esq., well known for his valuable contributions both to Mineralogy and Crystallography.

† In honor of Dr. Crichton.

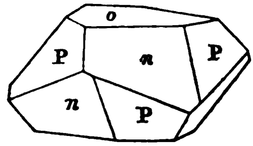


P on P'	61° 20'
P or P' on P''	118 45
——— on *a*	97 12
P'' on *a*	83 20

occurs accompanying anatase, and on rock crystal, at St. stophe, near Oisans, in Dauphiné. It has not been anal- , but it is supposed to contain titanic acid and iron. By it is included with the next species. At Amity and roe, Orange county, N. Y., a mineral supposed to be chtonite, but which has not been analyzed, occurs in black ng crystals imbedded in serpentine and white limestone, mpanied by Brucite, spinel and rutile. The mineral in l laminated masses, found at Washington, Conn., formerly red to this species, and now described as a new mineral rof. Shepard, under the name of Washingtonite, seems to g to the next species.

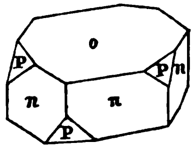
slightly affects the magnet. B B, on charcoal it is infusible, but with fluxes comports itself like oxide of iron.

1.



P on P over n . 85° 59′
P on n . . 158 00

2.



This species occurs imbedded in serpentine, and associated with apatite and sparry iron, at Inglisberg near Hoff, in the Gastein Valley, Saltzburg. It is also met with massive and compact at Eggersund in Norway, and imperfectly crystallized at Ilmensee and Ekatherineburg in Siberia. It was first described by Prof. G. Rose.

Washingtonite, *Shepard.* The earliest notice we have of the mineral now known by this name, is in *Shepard's Mineralogy*, vol. i. p. 150, where it is described under the species Crichtonite. The discovery of other localities of the mineral having since afforded some better defined crystals which are plainly distinct from those of Crichtonite, Prof. Shepard has supposed them to belong to a new species. But they seem to agree very nearly with Ilmenite or Axotomous iron, and they have therefore been here introduced as a variety of that mineral, appearing under a different secondary modification. Fig. 2 has been copied from an article by Prof. Shepard in the *Am. Jour. of Science*, vol. xlviii, p. 364. The faces are not sufficiently perfect for measurement with the reflecting goniometer, but planes P P, which had been varnished, afforded an approximate angle of 86°. The replacing planes are the most brilliant, and they sometimes convert the crystals into regular hexahedral tables. Cleavage very perfect parallel with P, affording planes more brilliant than the natural ones. Fracture uneven; lustre imperfectly metallic; color iron-black or greyish-black; slightly magnetic. According to Prof. Shepard, in specific gravity and hardness, this mineral rather exceeds axotomous iron; but in isomorphous minerals, in which the constituents replace each other in various proportions, we may well conceive that these characters are liable to vary, no less than the blowpipe characters.*

This variety occurs at Washington, Litchfield, and South Britain, Conn., at Westerby, R. I., and, according to Prof. Shepard, at Goshen, Mass.

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* For the chemical composition of Washingtonite, see the Appendix to this volume.

MOHSITE.*

Mohsite, *Levy*. (*Phil. Mag., new series*, ii. 286.) Uncleavable Iron Ore, *Shepard*.

Scratches glass easily.

Primary form a Rhomboid of 73° 45′. Occurs in twin crystals, flattened in a direction perpendicular to the axis, presenting the aspect of small flat tables, nearly circular, with alternate re-entering and salient angles on their edges. Cleavage not observable; color iron-black; opake; with a perfect metallic lustre; brittle; does not act on the magnet.

This species was noticed by Levy on a specimen which was understood to be from Dauphiné. It has not been analyzed, but it seems to stand in very near relation to Crichtonite.

COLUMBITE.†

Columbite, *Hatchett*. Tantalit, *Karsten*. Tantale Oxidé Ferro-manganésifère, H. Tantalite, J. A. Prismatic Tantalum Ore, M. Columbus rectangulus, D.

Combination of columbic acid with the protoxides of iron and manganese.

	Kimito.	Broddbo.	Zamela.
Columbic acid	83·2	68·22	83·44
Protoxide of iron	7·2	9·58	13·75
Protoxide of manganese	7·4	7·15	1·12
Oxide of tin	0·6	8·26	0·00
Tungstic acid	0·0	6·19	0·00
Lime	trace	1·19	0·00
	98·4 Berzelius.	100·59 Berzelius.	98·31 Nordenskiöld.

	Bodenmais.	Bodenmais.	New London, Conn.	Bodenmais.
Columbic acid	75·0	75·0	80·0	79·65
Protoxide of iron	20·0	17·0	15·0	14·00
Protox. of manganese	4·0	5·0	0·0	7·55
Oxide of tin	0·5	1·0	0·0	0·50
Lime	0·0	0·0	5·0	0·00
Moisture	0·0	0·0	0·0	0·05
	99·5 Borkowsky.	98·0 Vogel.	100·0 Wollaston.	100·75 Thomson.

The first specimen from Kimito analyzed by Berzelius, the third from Tamela by Nordenskiöld, and the sixth from Connecticut by Wollaston, give almost exactly one atom of columbic acid to one of the bases — protoxides of iron and manganese. It is evident that the iron is substituted for the manganese partly in the third specimen, and wholly in the sixth. In the first analysis the atoms of $\dot{\mathrm{C}}\mathrm{l}$ are 3·27, of $\underline{\mathrm{F}}$ 1·60, of $\underline{\mathrm{M}}\mathrm{n}$ 1·64. In the sixth, $\dot{\mathrm{C}}\mathrm{l}$ 3·51, $\underline{\mathrm{F}}$ 3·33 — with this, including the manganese with the iron, the third very nearly agrees. Whence we obtain the formula, $\mathrm{F}\dot{\mathrm{C}}\mathrm{l}+\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{C}}\mathrm{l}$, or simply $\underline{\mathrm{F}}\dot{\mathrm{C}}\mathrm{l}$.

Sp. Gr. 6·3 — 6·8. H. = 6·0.

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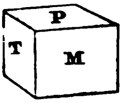
[*] Named by Levy in compliment of Professor Mohs.

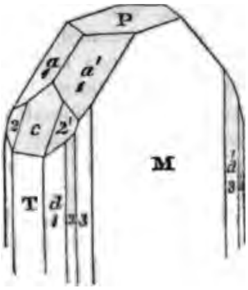
[†] Columbite, from its having been first discovered in America; whence Columbium, the designation of the pure metal, so named by Hatchett.

Color greyish or brownish-black; it occurs in single crystals, and in small crystalline masses; the crystals are mostly incomplete, but possess the general form of quadrangular prisms, striated longitudinally, shining externally and variously modified. The primary form as determined by Brooke is a Right rectangular prism. Cleavage parallel to M and T, rather distinct; streak brownish-black. It is opake, scratches glass, and gives sparks with the steel. Alone B B, none of the varieties of tantalite suffer any change; with borax, however, those of Kimito and Finbo, which contain large proportions of columbium, dissolve slowly but perfectly, communicating to it a faint green color; those, on the contrary, which contain less columbium, fuse readily into a black or extremely dark-green and almost opake glass. In heated sulphuric acid it is partly soluble, but it is wholly decomposed by fusion with sulphate of potash.

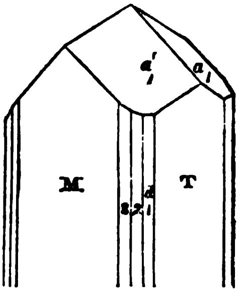
Primary.



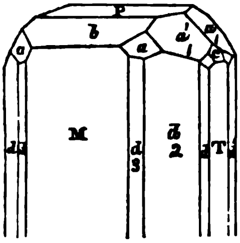
Bodenmais.



Middletown.



Middletown.



P on M or T	90°	00′	—Brooke.
M on T	90	00	"
P on $a1$ or $a1'$	136	30	"
—— e	120	00	"
T on $d1$	156	30	"
—— $d2$	114	30	"
—— c	150	00	"
P on b	160	34	—Dana.

Fig. 1 represents a crystal in the possession of Mr. Brooke. The lateral position of the two last figures is reversed.

The most crystalline foreign varieties of this species have occurred at Bodenmais in Bavaria, associated with beryl and uranite. It is obtained in granite at Kimito in Finland, at

Finbo near Fahlun with topaz, and at Rabenstein near Zwiesel in Bohemia.

In the United States this mineral occurs at Haddam and Middletown, Conn., accompanying the chrysoberyl, &c., at the former place, and imbedded in felspar with uranite and rutile, at the latter. The crystals present very regular and highly finished planes, and though usually small, have sometimes been met with several inches in length, and in one instance, of fourteen pounds in weight. Prof. Johnston, of the Wesleyan University, possesses one of these gigantic crystals, and has published a description of it in the *Amer. Jour. of Science*, xxx. p. 387. Fig. 3 is given on the authority of Dr. Torrey, and fig. 4, has been copied from a paper by J. D. Dana*. At Chesterfield, Mass., very distinct crystals have been found in granite with beryl and tourmaline. According to Shepard, large and perfect crystals were formerly found at Ackworth, N. H., but the locality appears to be exhausted. Columbite was first discovered near New London, Conn., and the specimen now in the British Museum, originally examined by Hatchett, and subsequently by Wollaston, came from this place, and was sent by Gov. Winthrop to Sir Hans Sloane.

Torrellite of Dr. Thomson. In the fourth volume of the *Records of General Science*, Dr. Thomson has given the description and analysis of a mineral sent to him by Dr. Torrey as Columbite, and which he has named Torrellite, as a new species, in honor of that gentleman. It came from Middletown, the well known locality of Columbite. In hardness and specfic gravity, it is much inferior to the Bohemian Columbite, but is similar in its characters B B. From the measurement of an imperfect crystal, Dr. Thomson determined the primary form to be a Right oblique prism, thus differing from Columbite, the primary form of which is a Right rectangular prism. M on T (mean of several trials) 84° 20′, (see fig. 11, p. xxix. of the *Introduction* to this vol.) T on a plane replacing the acute lateral edge G, 152°, M on the same plane 110° 20′. The opposite acute solid angle B, is replaced by a triangular plane inclining on the adjacent edge, at an angle of about 143° 45′. Proportions between the length and breadth of the crystal, apparently the same as in columbite. Color black, or much darker than columbite; surface irridescent, with a play of blue and green colors; lustre imperfectly metallic, almost resinous, being very similar to that of cherry coal. Structure foliated parallel with M. Cross fracture granular. Opake. Its analysis afforded these products:

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* Annals of the Lyceum of Nat. His. New York, i. p. 89. Amer. Jour. of Science, xxxii. p. 149.

Columbic acid	73·90
Protoxide of iron	15·65
Protoxide of manganese	8·00
Water	0·35
	97·90

These numbers correspond with two atoms dicolumbate of iron, and one atom dicolumbate of manganese. Formula, as given by Dr. Thomson: $2\underline{F}^2\dot{C}l+\underline{M}n^2\dot{C}l$.

CHROMATED IRON.

Siderite Chromifère, N. Eisenchrom, L. Prismatic Chrome Ore, J. Octahedral Chrome Ore, M. Chromeisenstein, W. Fer Chromaté, H. Bt. Siderus Chromicus, D.

Combination of oxide of chromium with peroxide of iron and alumina.

	Siberia.	Bare Hills, Md.	Chester, Penn.
Oxide of chromium	53·0	52·95	51·36
Peroxide of iron	34·0	29·24	35.14
Alumina	11·0	12·22	9·72
Silica	2·0	3·09*	2·90
	100·0 Laugier.	97·50 Thomson.	99·32 Seybert.

	Bare Hills, Md.	Bare Hills, Md.
Oxide of chromium	51·6	39·51
Peroxide of iron	35·0	36·00
Alumina	10·0	13·00
Silica	3·0	10·60
	99·6 Berthier.	99·11 Seybert.

Vauquelin, who first discovered chrome in this mineral, considered it a combination of chromic acid with oxide of iron, but Laugier has shown that the chromic acid was formed in the process by igniting the mineral with potash. Dr. Thomson supposes the silica shown in these analyses, to have been mechanically mixed with the specimens, in consequence of sufficient care not having been used in selecting pure crystals. His analysis was obtained from perfect octahedral crystals, and it gave only a trace of silica, approaching very nearly to two atoms oxide of chrome, one atom peroxide of iron, and one atom alumina. As the oxide of chrome is supposed to act the part of an acid, the formula is thus stated: $\underline{F}\bar{C}h+Al\bar{C}h$. If we suppose with Rammelsberg and others, that this mineral in its purest state is only oxide of chrome and protoxide of iron, or $\underline{F}\bar{C}h$, it corresponds with pleisto-magnetic iron ore, the form of which it assumes, the peroxide of iron being replaced by oxide of chromium.

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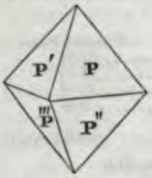
* White matter.

Sp. Gr. 4·3 — 4·6. H. = 5·5.

Occurs massive, disseminated in grains, and crystallized in the Regular octahedron, which is its primary form; cleavage parallel to all the planes of that figure; color iron-black or brownish-black; the massive has sometimes, though rarely, a perfectly lamellar structure, the fracture being commonly imperfect conchoidal and uneven, with a shining and somewhat metallic lustre; occasionally magnetic; has a brown streak, and is opake. Insoluble in nitric acid, and infusible B B, without addition, becoming magnetic when exposed to the inner flame; but with borax, or salt of phosphorus, it melts slowly, though completely, and on cooling exhibits the fine green of the oxide of chrome, which becomes still more intense on the addition of tin. When fused in powder with soda, it gives a yellowish dross, colored by oxide of chrome.



P on P′ or P″ . . . . 109° 28′

Chromated iron forms irregular veins in serpentine at Gassin in the Department du Var, near Nantes; in the Gulsen mountains near Kraubat in Styria; in the Uralian mountains of Siberia; in the Shetland isles of Unst and Fetlar; near Portsoy in Banffshire; and in St. Domingo, it is found in octahedral crystals.

In the United States, very perfect and brilliant octahedral crystals, with their edges replaced, are found in the serpentine of Bare Hills near Baltimore, Md., and also at Hoboken, N. J., imbedded in serpentine and dolomite. It occurs also at Milford and New Haven, Conn., and at New Fane, Vt.

Its large proportion of chrome renders this a highly valuable ore. It is employed as a pigment, — yielding, in combination with the oxides of other metals, green, yellow, and red colors, which are used in oil-painting, and coloring porcelain.

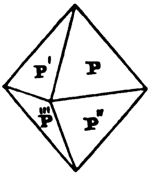
HAUSMANNITE.

Hausmannite, *Haid.* Pyramidal Manganese Ore, M. Black Manganese. Manganese Oxidé Hydraté, H. Blättricher Schwarz Braunsteinerz, *Hausmann.* Foliated Black Manganese Ore, J. Manganus acrotomus, D.

Anhydrous red oxide of manganese, mixed with a small proportion of the peroxide. The analysis by Dr. Turner, gave red oxide of manganese 98·098, oxygen 0·215, water 0·435, barytes 0·111, silica 0·337. The red oxide of manganese (*oxidum manganeso-manganicum* of Arfwedson) consists of one atom protoxide, and two atoms sesquioxide of manganese. As the other ingredients are doubtless accidental, the formula for this mineral is therefore, $\mathrm{Mn}\underset{\cdot}{\mathrm{Mn}}^2$.

Sp. Gr. 4·72 — 4·8. H. = 5·0 — 5·5.

It occurs massive and crystallized. Its primary form is an octahedron with a square base. Cleavage indistinct parallel with the octahedral faces, but readily obtained parallel with the base. Color iron-black, opake; very hard, and affords a dark-reddish or chesnut-brown powder. Lustre imperfect metallic. On charcoal in a strong heat it fuses on the edges; with borax readily forms a deep violet-blue or almost black globule; and with soda produces a green colored scoria. Is insoluble in muriatic acid, but is decomposed by heated sulphuric acid.



P on P'' or P' on P''' ..... 117° 30'
P on P' or P'' on P''' 105 45

Hausmannite is found in veins of porphyry, along with other ores of manganese, at Œhrenstock near Ilmenau in Thuringia; at Ihlefeld in the Hartz; and at Lebanon in Pennsylvania, United States. The most distinctly crystallized specimens are met with at Framont in Alsatia; but it is on the whole not a common species. The summits of the pyramids are sometimes replaced by low four-sided pyramids.

BRAUNITE.*

Brachytypous Manganese Ore, M. Brachytypous Manganerz, L. Manganus peritomus, D.

It is an anhydrous sesquioxide of manganese. The variety from Elgersburg yielded to Turner, protoxide of manganese 86·94, oxygen 9·85, water 0·95, and baryta 2·26. Divided by the atomic weights, the atoms of oxygen are very nearly half those of the protoxide of manganese; it is therefore a sesquioxide. Formula: $\underset{\cdot}{\mathrm{Mn}}$.

Sp. Gr. 4·8 — 4·9. H. = 6·0 — 6·5.

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* Named by Turner and Haidinger, in compliment to their mutual friend Mr. Braun of Gotha. A valuable paper by these gentlemen, on the Manganesian Minerals, has been published in the Edinb. Trans. xii. 119 and 143.

Primary form, an Octahedron with a square base whose faces, according to Haidinger, are inclined at angles of 109° 58′, and 108° 39′. Secondary form the same, occasionally truncated. Occurs both crystalline and massive, frequently fibrous and divergent, of a dark brownish-black color, with an imperfect metallic lustre; streak black or slightly brownish; cleavage distinct parallel to the faces of the primary; fracture uneven; brittle. It is soluble in muriatic acid, leaving a trace of siliceous matter. B B, on charcoal it is, *per se*, infusible, but assumes in the reducing flame a reddish color. With borax it melts with a slight effervescence.

This species of manganese forms veins in porphyry at Œhrenstock near Ilmenau, at Elgersburg, Friedrichsroda, and elsewhere in Thuringia; also with red epidote at St. Marcel in Peidmont. Besides its superior hardness to other ores of manganese, the direction of its cleavage parallel to the faces of the pyramid, sufficiently distinguishes this species from Hausmannite, in which the cleavage always takes place parallel to the base.

PYROLUSITE.*

Prismatic Manganese Ore, M. Manganus prismaticus, D. Grey ore of Manganese.

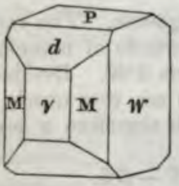
It is an anhydrous binoxide of manganese, united with several accidental substances.

Binoxide of manganese	98·14	97·835	99·242
Water	1·86	1·120	0·000
Barytes	0·00	0·532	0·000
Silica	0·00	0·513	0·840
Peroxide of iron	0·00	0·000	0·130
	100·00 Arfwedson.	100·000 Dr. Turner.	100·212 Dr. Thomson.

Formula: $\underset{\cdot}{\mathrm{M}}\underset{\cdot}{\mathrm{n}}$.

Sp. Gr. 4·6—4·9. H.=2·0—2·5.

Primary form a Right rhombic prism. Color iron-black, sometimes bluish; opake; lustre metallic; streak black; cleavage parallel to M, *v*, and *w*.



M on M over *v* . . . . 93° 40′

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* Pyrolusite, from πυϱ, *fire*, and λουω, *I wash*, in allusion to its valuable property of discharging the brown and green tints in glass.

B B, at a powerful heat, in the reducing flame, it becomes brownish-red, but does not fuse; is soluble with brisk effervescence in borax, coloring the globule of an amethystine tinge, but yields no water when heated in the matrass.

In an economical point of view, pyrolusite is the ore of manganese properly so called, and is extensively worked in many countries, particularly at Ilmenau, Friedrichsroda, Elgersburg, and other places in Thuringia. The mines of Ehrensdorf, near Maehrisch-Triebau in Moravia, afford annually many hundred tons of this ore; and in Cornwall, Devonshire, Saxony, France, Hungary, and other countries, it is of more or less frequent occurrence. In all these localities it is associated with psilomelane, from which, however, it is easily distinguished by its greatly inferior hardness; indeed it is generally so soft as, even in crystalline specimens, to soil the finger when handled. At first sight it may be confounded with certain crystallized varieties of antimony; but its dark steel-grey color is sufficiently characteristic; and if not, the blowpipe will distinguish it, pyrolusite being perfectly infusible, while antimony yields even to the flame of a candle. — *Allan's Manual.* The annual consumption of this ore in Great Britain is about 30,000 tons, nearly a third of which is consumed in Glasgow. — *Thomson.*

In Nova Scotia and New Brunswick, it is frequently met with in scattered masses through the new red sandstone, but it does not occur in regular beds.

In the United States this mineral frequently accompanies the deposits of brown hæmatite iron, and is both massive and in crystals. Bennington, Vt., has supplied the largest quantities of the massive variety. Salisbury and Kent, in Conn., Richmond and Lennox, Mass., have afforded many distinctly crystallized specimens.

GREY OXIDE OF MANGANESE.

MANGANITE.

Grau Braunsteinerz, W. Manganese Oxidé Metalloide, H. Prismatoidal Manganese Ore, M. Manganite, *Haidinger.* Prismatic Manganese Ore, J. Hydrated Deutoxide of Manganese, *Turner.* Acerdise, *Beudant.* Manganus rhombicus, D.

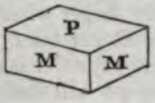
	Ihlefeld.		Undenaes.
Protoxide of manganese	86·85	87·1	86·41
Oxygen	3·05	3·4	3·51
Water	10·10	9·5	10·08
	100·00 Turner.	100·0 Gmelin.	99·95 Arfwedson.

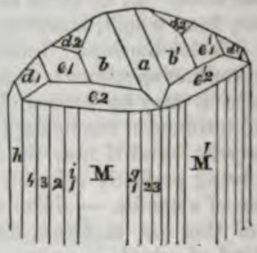
According to Dr. Thomson this mineral is a hydrated sesquioxide, and differs from Braunite only in containing one atom of water. Formula: $\dot{Mn}^2Aq$.

Sp. Gr. 4·31 — 4·4. H. = 4·0 — 4 2.

Color steel-grey, passing into iron-black; occurs in prismatic crystals, which are occasionally modified; cleaves readily and with brilliant surfaces parallel to the lateral planes of a Right rhombic prism of 100° and 80°* (the primary form), and both its diagonals. It occurs also in acicular crystals longitudinally striated, either diverging, or confusedly intersecting each other; also massive, with a fibrous structure, or having a granular or earthy texture; lustre imperfect metallic; opake, except in the thinnest fragments, which exhibit a feeble translucence; brittle; marks strongly when rubbed, giving a dark reddish-brown, and in the massive varieties a black, streak.

Primary.





P on M or M'	90°	00'	M on *g*2	168°	00'
M on M'	100	00	—— *g*3	152	35
P on *a*	115	02	—— *h*	130	00
M on *b* or M' on *b'*	121	35	—— *i*1	174	30
—— *d*1 ———— *d*1' . . .	138	00	—— *i*2	168	52
—— *d*2 ———— *d*2' . . .	125	00	—— *i*3	161	00
—— *e*1 ———— *i*1' . . .	130	20	—— *i*4	155	12
—— *e*2 ———— *e*2' . . .	149	30	*d*1 on *e*1	162	00
M on *g*1	171	30	*e*1 on *b*	168	12

B B, it yields water in the matrass. *Per se*, it is infusible, but assumes a reddish tinge in the oxidating flame. With borax it affords a violet-blue colored globule. It is insoluble in nitric acid, but in muriatic it gives off chlorine, and dissolves without residue; when exposed to a powerful heat, oxygen is disengaged.

This is the purest and most beautifully crystallized ore of manganese. It occurs both in primitive and secondary formations, in veins, beds, and irregular masses. Its principal locality is Ihlefeld in the Hartz, where it is associated with calcareous spar and barytes, in veins traversing porphyry. It occurs also, though less abundantly, in Bohemia, Alsatia, Saxony, Aberdeenshire, Cornwall, and at Undenaes in West

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* According to Necker, 99° 41' and 80° 19'.

Gothland. It is distinguished from pyrolusite by its superior hardness and characteristic brown streak, which sometimes appears black until a portion has been abraded.

PSILOMELANE.*

Uncleavable Manganese Ore, M. Compact and Fibrous Manganese Ore, or Black Hematite, J. Black Iron Ore. Schwartz Eisenstein. Schwartzer Glaskopf, W. Dichtes Schwartz Manganerz, L. Manganese Oxidé Hydraté Concretionné. Manganese Oxidé Non-Barytifère, H. Manganus informis, D.

Though this ore has been placed by mineralogists among the oxides of iron, under the names of black hæmatite and black iron ore, pure fragments of it do not contain a trace of that metal.

	England.	Romanèche.
Red oxide of manganese	69·795	70·3
Oxygen	7·464	7·2
Barytes	16·365	16·5
Water	6·216	4·0
Silica	0·260	2·0
	100·000 Turner.	100·0 Berthier.

Formula, by Dr. Thomson: $2Mn^6Br+5\underset{\cdot}{M}\underset{\cdot}{n}Aq$.

Sp. Gr. 4·0 — 4·15. H. = 5·0 — 6·0.

Crystalline form unknown; massive and botryoidal; color black, passing into dark steel-grey; lustre imperfect metallic; opake; streak brownish-black, and shining; cleavage and fracture not observable. B B, it colors glass of borax violet-blue, like other ores of manganese; and is completely soluble in muriatic acid, with the exception of a small quantity of silica.

This species is frequently associated with pyrolusite, sometimes even alternating with it in layers of different thickness; and occurs in botryoidal and stalactitic-shaped masses in Devonshire and Cornwall; at Ihlefeld in the Hartz; in the district of Siegen in Hessia; and at several places in Saxony, Silesia, and Bayreuth. The Romanèche variety possesses a somewhat higher specific gravity.

VARVACITE.†

Richard Phillips. (*Phil. Mag. 2nd series*, v. 209.)

This mineral, first named and described by R. Phillips, is composed, according to his own analysis, as follows:

Protoxide of manganese	81·12
Oxygen,	13·48
Water	5·40
	100·00

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* Psilomelane, from ψιλος, *smooth* or *naked*, and μελας, *black*, in allusion to its smooth or botryoidal form, and black color.

† From its occurring in the county of Warwick.

These numbers give two atoms binoxide and two atoms sesquioxide of manganese, united with one atom water. Formula: $2\underset{..}{\mathrm{Mn}}2\underset{.}{\mathrm{Mn}}+\mathrm{Aq}$.

Sp. Gr. 4·28—4·53.

Color grey, not differing much from that of pure binoxide. It is composed of thin plates and fibres, without any regular crystalline shape, often radiating. Lustre metallic; opake. According to Dr. Turner (*Chemistry*, p. 420, *seventh edition*,) this is found in the manganese ore of Ihlefeld in pseudomorphous crystals in the form of the six-sided prisms of calcareous spar.

HYDROUS BINOXIDE OF MANGANESE.

This mineral was first described and analyzed by Berthier.[*] It is contained in, or forms the principal part of an ore of manganese from three different localities. The analyses are thus given:

	Groroi.	Vecdessoss.	Caustern.	
Protoxide of manganese	62·4	68·9	46·5	13·86 [†]
Oxygen	12·8	11·7	7·1	12·8
Water	15·8	12·4	8·8	14·04
Peroxide of iron	6·0	0·0	3·6	1·2
Clay	3·0	7·0	Quartz 33·6	0·00
	100·0 Berthier.	100·0 Berthier.	99·6 Berthier.	

Of the first analysis Dr. Thomson observes, that the whole protoxide of manganese to be converted into the deutoxide, would require 13·8 atoms of oxygen; but only 12·8 atoms were obtained. Hence the mineral must have been a mixture or compound of 11·8 atoms binoxide, two atoms sesquioxide, fourteen atoms water. It is obvious that every atom of the oxides of manganese in the mineral, was combined with an atom of water. We have then a compound of six atoms binoxide of manganese, one atom sesquioxide of manganese, seven atoms water. But as there is a great variation in the quantity of sesquioxide in the three specimens, Berthier has regarded it as accidental; and the mineral may thus consist of one atom binoxide of manganese, one atom water. Formula: $\underset{..}{\mathrm{Mn}}\mathrm{Aq}$; or $6\underset{..}{\mathrm{Mn}}+2\underset{.}{\mathrm{Mn}}+14\mathrm{Aq}$, if we adopt the first analysis.

This mineral occurs in rolled masses, in a bed of sand and clay. Color brownish black; dull; here and there metallic. Its powder has a slight chocolate color. By ignition it loses 24 per cent. of its weight in water and oxygen, without changing its form, but acquiring a reddish color. It dissolves slowly in concentrated sulphuric acid, to which it communicates a fine violet-red color. Oxalic acid attacks it readily, even without heat, and two and a half times its weight of this acid are required to disoxidise it completely. Sulphurous acid dissolves it almost instantly.

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[*] Memoirs by Berthier, ii. p. 230.

[†] Atoms answering to the first analysis.

An ore of manganese somewhat resembling that above described, but differing slightly in its composition — the *Hydrous Sesquibinoxide of Manganese* of Dr. Thomson, is found in the neighborhood of Cork. Its analysis gave Dr. Thomson, silica 22·90, sesquioxide of manganese 23·48, binoxide of manganese 17·22, peroxide of iron 28·64, water 8·05. To suppose this mineral to be a hydrous sesquibinoxide of manganese, requires that we throw out the silica and oxide of iron as accidental.

WAD.

Earthy Manganese. Black Wad. Manganus terrenus, D.

Contains, according to Klaproth, oxide of manganese 68·0, oxide of iron 6·5, water 17·5, carbon 1·0, baryta and silica 9·0. Specific Gravity 3·7, though apparently very light when taken in the hand.

It occurs of various shades of brown, blackish-brown, and grey, sometimes approaching to steel-grey. It is commonly dull, but the grey possesses a glimmering lustre. Occurs massive, botryoidal and amorphous, sometimes pulverulent; or in froth-like coatings on other minerals. The massive commonly yields to the nail and soils the fingers. From its giving off water abundantly on exposure to heat in the matrass, it is considered by Berzelius as a hydrate of manganese.

It occurs principally at the manganese pits of Upton Pyne, Devonshire; in Cornwall, the Hartz, and in Piedmont.

CUPREOUS MANGANESE.

Kupfer Mangan *of the Germans*. Manganese Hydraté Cuprifère, *Necker*. Cupreous Manganese, J. Manganus Cupriferus, D.

Hydrate of the oxide of manganese, mixed with oxide of copper and gypsum.

Oxide of manganese	74·10
Oxide of copper	4·80
Water	21·10
Gypsum	1·05
Silica	0·30
	100·45 Kersten.

Rammelsberg has thus given the chemical formula for this mineral — $\dot{C}u\ddot{\bar{M}}n\dot{\bar{H}}^{9}+3\dddot{\bar{M}}n^{2}\dot{\bar{H}}^{3}$.

Sp. Gr. 3·15 — 3·25. H. about 1·5.

Is found massive, in small reniform and botryoidal opake groups of a bluish-black color; lustre resinous; streak corresponding to the color; not brittle. B B, it becomes brown, but is infusible; to borax or salt of phosphorous it communicates the amethystine and green colors characteristic of manganese; with a mixture of soda and borax, grains of reduced copper are obtained. This very rare mineral occurs in the tin mines of Schlaggenwald in Bohemia, and was first distinguished by Breithaupt and Lampadius.

HELVINE.*

Helvine, W. and H. Tetrahedral Garnet, M. J. Carbunculus hemihedrus, D.

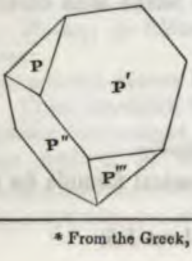
Combination of silica, glucina, alumina, and the protoxides of iron and manganese.

	Schwartzenberg.	
Silica	35·27	33·258
Alumina	1·45	12·029
Glucina	8·02	
Protoxide of manganese	29·35	31·817
Protoxide of iron	7·99	5·564
Sulphuret of manganese	14·00	14·000
	97·823 Gmelin.	97·231 Vogel.

There is some uncertainty as to the atomic composition of this mineral, owing to the presence of sulphuret of manganese. Regarding this as accidental, Dr. Thomson has given the formula thus: $\underline{F}S^2+CS^2+6\underline{M}nS$.

Sp. Gr. 3·1 — 3·3. H. = 6·0 — 6·5.

Primary form the Regular tetrahedron. Occurs in small tetrahedrons, whose solid angles are replaced; of a pale wax-yellow color, inclining to brown or siskin-green; translucent on the edges; lustre vitreous, inclining to resinous; and streak white. B B, on charcoal, in the reducing flame, it fuses into an opake globule of nearly the same color as the mineral; with borax it melts slowly into a diaphanous glass, which remains yellow when cold, if the dissolution be not complete; and which, when it is complete, becomes colorless in the reducing, and of a deep amethystine tinge in the oxidating flame.



P on P′ or P″ . . . . 109° 30′

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* From the Greek, signifying *sun-yellow*; in allusion to its color.

Schwartzenberg in Saxony, where it occurs in beds of gneiss, accompanied with garnet, quartz, fluor, and calc spar, and Hortekulle, near Modum in Norway, are the best known localities of helvine.

SILICATE OF MANGANESE.

Dr. Thomson. (*Outlines, &c.,* i. 514.)

This mineral accompanies the Franklinite and red oxide of zinc at Franklin, N. J. It was analyzed by Dr. Thomson in 1825, and with the following results:

Silica	29·64
Protoxide of manganese	66·60
Peroxide of iron	0·92
Moisture	2·70
	99·86

The atoms of silica are 14·82, and the atoms of protoxide of manganese 14·80, showing the mineral to be a simple silicate. Formula: $\underline{M}nS$.

Sp. Gr. 4·078. H. — 6·25.

Color light brownish-red. Massive; structure foliated. Two cleavages are very distinct at right angles, or nearly so, to each other. There is a third cleavage perpendicular to the two others, but it is very imperfect. Hence the primary form seems to be a right oblique prism, which differs only by 3° or 4° from a right angle. Lustre shining and vitreous; opake. Powder light red, becomes brown by ignition and loses 2·7 per cent. of its weight. It dissolves, by digestion, in dilute muriatic acid without effervescence.

SESQUISILICATE OF MANGANESE.

Dr. Thomson. (*Outlines, &c.,* i. 514.)

This mineral occurs under precisely the same circumstances with the last described, both at Franklin furnace and at the principal zinc mine. Dr. Thomson found it to consist of silica 42·40, protoxide of manganese 50·72, protoxide of iron 6·76. These numbers correspond with eight atoms sesquisilicate of manganese, and one atom tersilicate of iron. Formula: $8\underline{M}nS^{1\frac{1}{2}}+\underline{F}S^{3}$. But Dr. Thomson supposes the tersilicate of iron to be accidental, and the mineral to be a pure sesquisilicate of manganese.

Sp. Gr. 3·586. H. = 6·25.

Color brown, with a very slight shade of red. Texture foliated. Crystallized in six or eight-sided prisms, which are said to be several inches in length, and an inch in diameter. Texture foliated with a threefold cleavage, indicating for the primary form of its crystal a doubly oblique prism. M on T, as measured by Dr. Thomson, 56° 30′; the inclination of P to the axis, about 108°. Lustre vitreous; shining. Opake. This species has been named Fowlerite in compliment to Prof. Fowler.

TROOSTITE.*

Ferruginous Silicate of Manganese, *of Dr. Thomson.* Spatinius rhombohedrus, D.

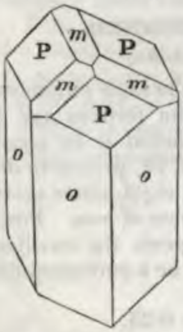
This is another of the manganesian salts found with the Franklinite and other analogous substances at Franklin, in New Jersey. It is unlike the other silicates of this metal in being in large and perfectly defined crystals. We are indebted to Dr. Thomson for its analysis, as follows:

Silica	30·650
Protoxide of manganese	46·215
Peroxide of iron	15·450
Carbonic acid and water	7·300
	99·615

Dr. Thomson has given this formula — $3\underline{M}nS+\underset{\cdot}{F}S^{1\frac{1}{4}}+2Aq.$

Sp. Gr. 4·0 = 4·1. H. = 5·5.

Color greenish, yellow, grey, and reddish-brown; with vitreous lustre inclining to resinous; transparent to translucent. Primary form an obtuse rhomboid, P on P 115°, as measured with the common goniometer. It cleaves parallel with the lateral planes of the annexed figure, which represents the common secondary form of this mineral. These lateral planes are comparatively smooth, and shining, while P and *m* are dull. Fracture conchoidal. Brittle. Streak white.



P on *m*	147° 30′
P on *o*	122 00
m on *o*	109 00
o on *o*	120 00

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[*] In honor of Professor Gerard Troost, of Nashville, Tenn.

B B, it becomes transparent and melts on the edges. With borax, it dissolves giving the violet tinge of oxide of manganese. It dissolves with effervescence in muriatic acid, some carbonic acid gas being evolved, and silica remaining.

NEWKIRKITE.

Dr. Thomson. (Outlines, &c., ii. 509.)

Dr. Thomson has separated this from the grey ore of manganese, with which it had long been confounded, and has given us the following account of it. Composed of binoxide of manganese 56·30, peroxide of iron 40·35, water 6·70. Formula: $3\underset{..}{Mn}Aq+2\underset{.}{Mn}\underset{.}{F}^2$.

Sp. Gr. 3·824. H. = 3 — 3·5.

Color brilliant black; lustre metallic; splendent. Occurs in small needles which, when viewed through a powerful microscope, assume the appearance of a Right rectangular prism. But they are not susceptible of measurement. They form a coating on red hematite. Opake, rather rectile. Locality at Newkirchen in Alsace.

BISILICATE OF MANGANESE.

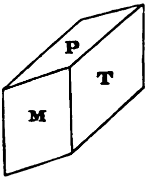
Manganese Oxidé Silicifère, H. Silicate of Manganese, A. Manganese Spar, J. Manganspath, W. Spatinius decolorans, D.

	Langbanshyttan.	New Jersey.	
Silica	48·00	48·58	48·00
Protoxide of manganese	48·98	38·92	49·04
Protoxide of iron	traces	13·50	0·00
Lime	3·12	0·00	3·34
Magnesia	0·22	0·00	0·00
Water	0·00	3·00	0·00
Carbonic acid	0·00	3·23	0·00
	100·32 Berzelius.	99·23 Thomson.	100·38 Rose.

Taking the analyses by Berzelius and Rose, which were of the purest specimens, we obtain for the constitution of this mineral, two atoms silica, and one atom protoxide of manganese. Formula: $\underline{Mn}S^2$.

Sp. Gr. 3·5 — 3·7. H. = 5·0 — 5·5.

It occurs massive; of a pale rose-red color. The fracture is even or flat conchoidal; it is translucent on the edges, and is very hard; lustre intermediate between pearly and resinous; cleavage apparent in two directions perpendicular to each other, exhibiting as the primary form a Doubly oblique prism; that parallel to P highly perfect. M on T 121°; M on P 93° to 94°; T on P 112° 30′.



Alone B B, on charcoal it becomes dark brown, and fuses into a reddish-brown or black globule. With borax it forms a violet-colored glass. Reduced to powder and treated with muriatic acid, it is partly dissolved; the insoluble remainder assuming a white color.

It occurs at Langbanshyttan in Wermeland, Sweden, in beds of iron ore; at Ekatherineburg in Siberia; at Elbingerode in the Hartz; in Devonshire on Black Down, near Tavistock, associated with grey oxide of manganese; and in Cornwall, near Calington, in a manganese quarry.

In the United States it occurs at Cummington, Mass., in rolled masses scattered through the soil. Specimens recently obtained are sometimes of a beautiful pink color. It is found also at Franklin, N. J., with the other siliceous compounds of this metal.

It is cut and polished by the lapidary, and employed for inlaid work.

The substances described by Leonhard and Jasche under the names of *dialogite*, *tomosite*, *manganese pyrope*, *allagite*, *photizite*, *rhodonite*, and *corneous manganese*, all from the vicinity of Rubeland in the Hartz, are evidently compact varieties of this species under different states of oxidation, and in more or less perfect conditions of purity.*

	Allagite.	Rhodonite.	Photizite.	Corneous Manganese.
Oxide of manganese	75·0	49·87	46·13	54·58
Silica	16·0	39·00	39·00	34·00
Carbonic acid	7·5	4·00	11·00	8·00
Alumina	0·0	0·12	0·25	0·00
Water	0·0	6·00	3·00	2·00
Oxide of iron	0·0	0·25	0·50	0·50
	98·5 Du Menil.	99·24 Du Menil.	99·88 Brandes.	99·08 Brandes.

The rhodonite has frequently a fibrous texture, and, as well as the photizite and corneous manganese, presents various red, green, and grey colors, which become darker on exposure to the air. The allagite is analogous in composition with disilicate of manganese.

HYDROSILICATE OF MANGANESE.

Opsimose, *Beudant*. Schwarzer Mangan-Kiesel.

Consists, by the analysis of Klaproth, of silica 25, protoxide of manganese 60, water 13. Formula: $\underline{Mn}S+Aq$, or it is a simple hydrosilicate of manganese.

Occurs compact, of a black color and metallic appearance;

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* These names were introduced by C. F. Jasche, who has described these manganesian salts at length in the Trans. of the Russian Imp. Min. Soc., vol. i. part 2d. 1842.

streak brownish-yellow. Gives off water in the matrass, and becomes grey. Is fusible into a green glass in the reducing flame, and forms a black one in the oxidating. Upon platina foil it communicates a green color to soda. Is acted upon by acids.

Locality, Claperude in Dalecarlia, Sweden.

KNEBELITE.*

Lenz and *Dobereiner.*

It contains according to the analysis of Dobereiner,

		Atoms.
Silica	32·5	16·25
Protoxide of iron	32·0	7·11
Protoxide of manganese	35·0	7·77
	99·5	

The constitution of this mineral thus approaches very nearly to one atom silicate of iron, and one atom silicate of manganese. Formula: $\underline{F}S+\underline{Mn}S$.

Sp. Gr. 3·714.

Color grey, spotted with dirty white, brownish-red, brown, and green; it is massive, but the surface is cellular and uneven; and both internally and externally it is glistening; fracture imperfectly conchoidal; is opake, hard, brittle, and difficultly frangible. No locality is given.

BUSTAMITE.

Brogniart. (*Ann. des Mines*, 2d series, i. 272.)

It is composed, according to the analysis of Dumas, of

		Atoms.
Silica	48·90	24·45
Protoxide of manganese	36·06	8·01
Lime	14·57	4·16
Protoxide of iron	0·81	0·18
	100·34	

The numbers show it to consist of two atoms bisilicate of manganese, and one atom bisilicate of lime.

Formula: $2MnS^2+CalS^2$.

Sp. Gr. 3·1 — 3·3. H. about 7·0.

Occurs in irregularly disposed prismatic crystals, having a somewhat fibrous structure, and a pale grey, greenish, or reddish color; almost opake. It occurs, associated with iron pyrites, at Real de Minas in Mexico, and was first noticed as new by M. Bustamente, in compliment to whom it has been named.

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* After Major Von Knebel who presented the mineral to Dobereiner.

SULPHURET OF MANGANESE.

Mangan Blende, *Breithaupt.* Hexahedral Glance Blende, M. Prismatic Manganese Blende, J. Schwartzerz, *Hausmann.* Manganèse Sulfuré, H. Manganglanz, *Leonhard.* Alabandine, *Beudant.* Acarpia cubica, D.

Combination of one atom sulphur and one atom manganese, or in parts, of manganese 66·95, sulphur 53·65. Formula: $MnSl$.

Sp. Gr. 3·95—4·05. H.=3·5—4·0.

Primary form the Cube. Secondary form the regular octahedron. Cleavage parallel to the primary faces distinct; traces parallel to its edges.

Color brownish-black, but, when fresh fractured, of a dark steel-grey; it occurs massive, sometimes botryoidal, with an imperfect metallic lustre; fracture commonly fine grained; streak dark-green; opake. B B it fuses with difficulty, and only on the thinnest edges, forming a brownish scoria; reduced to powder it is dissolved when thrown into acid, emitting at the same time fumes of sulphuretted hydrogen.

It occurs in the gold mines of Nagyag in Transylvania, with tellurium, blende, copper pyrites, and other ores of manganese; also in Mexico, and in Cornwall.

ARSENIURET OF MANGANESE.

Arseniet of Manganese, *Thomson.* Argyrites Manganicus, D.

For the discovery of this rare substance we are indebted to Mr. Robert J. Kane of Dublin,[*] who detected it in a mass of galena from Saxony.

Its analysis gave him manganese 45·5, arsenic 51·8, and a trace of iron=97·03. It probably consists of one atom manganese and one atom arsenic, or $MnAs$. This formula is obtained, if we suppose the loss to have been chiefly arsenic, otherwise there is a deficiency in this metal, the atoms being 13 to 10·9.

Sp. Gr. 5·55. H. not stated.

Its color is greyish white; texture foliated, fracture in one direction uneven, fine, granular and shining; in the opposite direction it is dull and earthy. B B, it burns with a blue flame, and falls to powder. In a stronger heat, an arsenical fume rises and coats the charcoal with a white dust. It dissolves in aqua regia without leaving any residue.

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[*] Quarterly Journal of Science, new series, vi. 381.

CARBONATE OF MANGANESE.

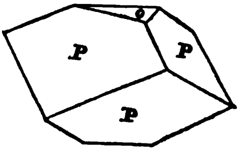
Manganese Oxydé Carbonatée, H. Rhomboidal Red Manganese, J. Macrotypous Parachrose Baryte, M. Red Manganese, A. Rothbraunsteiners, *Haidinger*. Kohlensaures Mangan, L. Rother Braunstein, W. Diallogite, *Beudant*. Marantalus decrepitans, D.

Carbonate of manganese, more or less mixed with the carbonates of iron and lime.

	Buchenberg.	Freyberg.	Nagyag.
Protox. of manganese	54·60	52·6	56·0
Carbonic acid	33·75	38·7	38·6
Oxide of iron	1·87	4·5	0·0
Silica	4·37	0·0	0·0
Lime	2·50	5·0	5·4
	97·09 Du Menil.	100·8 Berthier.	100·0 Berthier.

These analyses vary considerably. We obtain from the first 12·27 atoms carbonic acid, 12·13 atoms protoxide of manganese, or a simple carbonate of manganese. Formula: $\underline{Mn}\dot{C}$.

Sp. Gr. 3·3 — 3·6. H. = 3·5.



P on P . . . . . . 106° 51′

Primary form an Obtuse rhomboid of 106° 51′.* Cleavage parallel to the faces of the rhomb. Surface of *o* deeply streaked parallel to its edges of combination with P; this produces lenticular crystals, and when the surface of P is curved, those peculiar saddle-shaped lenses so common in this species are formed. It also occurs massive. Color rose-red, and translucent; possesses a lamellar structure; scarcely scratches glass, and yields to the knife; fracture splintery; lustre vitreous, inclining to pearly.

B B, its color is changed into brown or black, and it decrepitates strongly, but is infusible without addition. It is readily soluble in, and colors borax or salt of phosphorus violet-blue in the oxidating flame, becoming, however, colorless in the reducing flame; it effervesces rather briskly in nitric acid. On exposure to the air, it becomes browner in color; and the bright rose-red varieties lose their hue from the action of light.

This species generally occurs in metalliferous veins accompanying various ores of silver and lead, both massive, and in botryoidal concretions coating cavities. The mines of Freyberg in Saxony, and those of Kàpnik, Offenbanya, and Nagyag in Transylvania, are its principal localities. It is apt to be confounded with manganese spar, though its very inferior degree of hardness is sufficiently characteristic. — *Allan's Manual.*

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* 103° and 77°, according to Beudant.

PELOKONITE.

Richter. (*Poggendorf's Annalen*, xxi. 590.)

A mixture of hydrous oxide of manganese, hydrous oxide of iron, oxide of copper, and silica. — *Kersten.*

Sp. Gr. 2·5 — 2·57.

Uncrystallized; color blackish blue; streak liver-brown, with a low degree of lustre, and conchoidal fracture.

It occurs at Remolinos in Chili, associated with malachite and chrysocolla, and derives its name from πελος *brown*, and κονις, *powder*, in allusion to the color of its streak, from which last property it may be distinguished from cupreous manganese.

HURAULITE.

Vauquelin. (*Ann. de Chim. et de Ph.*, xxx. 302.) *Dufrésnoy.* (*Ibid*, xli. 338.)

Combination of phosphoric acid, oxide of iron, oxide of manganese, and water.

Phosphoric acid	38·00	32·8
Protoxide of iron	11·52	47·2
Protoxide of manganese	33·21	
Water	18·00	20·0
	100·73 Dufrésnoy.	100·0 Vauquelin.

M. Dufrésnoy's analysis gives very nearly six atoms phosphate of manganese, two atoms diphosphate of iron, thirteen atoms water. Formula: $6\underline{\mathrm{M}}\mathrm{n}\dot{\mathrm{P}}\mathrm{h}+2\underline{\mathrm{F}}^{2}\dot{\mathrm{P}}\mathrm{h}+13\mathrm{Aq}$.

Sp. Gr. 2·27. H. above 3·0.

Primary form an oblique rhombic prism of 117° 30′; in minute translucent crystals of a reddish-yellow color; fracture conchoidal, with a vitreous lustre; heated in the matrass, it yields water. Alone it fuses readily B B, affording a black button, which has a metallic lustre.

Described by Dufrésnoy, who named it from its locality, the Commune des Huréaux in the Haute Vienne.

PHOSPHATE OF MANGANESE.

Phosphormangan, W. Manganèse Phosphatée Ferrifère, H. Phosphate of Manganese Pitchy Iron Ore, J. Manganese Phosphatée, Bt. Triplit, *Haidinger*. Manganeso-Diphosphate of Iron, *Thomson*. Marantalus quadratus, D.

Combination of phosphoric acid with the protoxides of iron and manganese.

		Atoms.
Phosphoric acid	32·8	7·28
Protoxide of iron	31·9	7·08
Protoxide of manganese	32·6	7·24
Phosphate of lime	3·2	0·00
	100·5	

It is thus constituted of one atom acid, and one atom each of the bases, (leaving out the phosphate of lime as accidental); or of one atom diphosphate of iron, one atom diphosphate of manganese. Formula: $Mn^3\dot{P}h+\underline{F}^2\dot{P}h$.

Sp. Gr. 3·4—3·8. H. = 5·0.

Occurs in compact cleavable masses of a brownish-black color; structure lamellar, with a brilliant and somewhat adamantine lustre; cleavage in three directions perpendicular to each other, one of them less distinct than the others, the primary form (thus indicated) being a Rectangular prism; fracture flat conchoidal; opake in the mass, but thin fragments are semi-transparent; streak yellowish-grey. Alone on charcoal, it fuses very easily with brisk intumescence into a black metallic-like globule, which is magnetic; with borax is readily soluble into a glass, which appears of an amethystine color in the oxidating flame, bottle-green in the reducing; with soda it is insoluble on charcoal, but on platina leaf exhibits a green color; and with boracic acid melts and forms, with iron wire, phosphuret of iron. Is slowly soluble, with effervescence, in nitric or muriatic acid.

It occurs in large-grained granite, near Limoges in France, associated with the beryl of that locality; also at Washington in Connecticut, with pulverulent Diallogite; and at Sterling in Massachusetts, with spodumene.

The *Dufrénite* of Brogniart, or *phosphate de fer manganesien vert* of Beudant, contains phosphoric acid 24·8, protoxide of iron 51·0, water 15·0, peroxide of manganese 9·0. Specific gravity 3·227. Is of an olive or dull-green color; in small radiated masses; slightly translucent; and extremely fusible, melting even on exposure to the candle. Occurs at Anglar near Limoges.

TRIPHYLINE.

Fuchs. (*Berzelius' Rapport Annuel*, 1835, p. 212.)

This mineral is analogous in some of its physical characters with the last species, but it occurs under a different crystalline form, and differs somewhat in its composition. Its constituents, according to Fuchs, are as follow:

Phosphoric acid	41·47
Protoxide of iron	48·57
Protoxide of manganese	4·70
Lithium	3·40
Silica	0·53
Water	0·68
	99·35

Answering to these numbers, Berzelius has given this formula: $\dot{\mathrm{L}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\text{Ᵽ}}+6(\dot{\mathrm{F}}\mathrm{e}^3\dot{\mathrm{M}}\mathrm{n}^3)\overset{\cdot\cdot\cdot\cdot\cdot}{\text{Ᵽ}}$.

Sp. Gr. 3·6. H. = 5.

Its color is greenish-grey, in some spots bluish; the powder greyish-white. Translucent in thin pieces. Fuses easily B B, loses by ignition 0·68 per cent. of water. Dissolves easily in borax into a greenish glass. Is soluble in acids. It occurs generally in a massive form, but presents a coarsely lamellar or crystalline structure, with cleavages parallel with the planes of a Right rhombic prism, M on M about 132°. The cleavage parallel with P, more perfect than with M.

This mineral occurs so abundantly in the neighborhood of Bodenmais, that it has been suggested whether it could not be employed in the arts.

Tetraphyline or *Perowskinite* of Nordenskiöld. This mineral, obviously very similar to the above, has not been fully investigated. It was analyzed by Berzelius and Nordenskiöld, (*Rapport Annuel,* 1835, p. 212), but the great excess caused them to reject the analysis. They obtained phosphoric acid 42·6, protoxide of iron 38·6, protoxide of manganese 12·1, magnesia 1·7, lithia 8·2 = 103·2. Its color is yellow on the fresh surface, but exposed to the air, it becomes gradually black. It gives, B B, a strong manganese reaction. It occurs at Keiti in Tammela, Finland.

Fuchs[*] has also examined another phosphate of manganese and iron, from Zwizel in Bavaria, in which he found 3·18 per cent. of fluorine with 35·60 phosphoric acid, 35·44 protoxide of iron, and 20·34 protoxide of manganese. The protoxide of iron enters into its composition in a proportion nearly approaching to two atoms against one of oxide of manganese. In designating these two oxides by R, Berzelius gives the following formula: $\mathrm{RF}^2+3(3\mathrm{Ro})\mathrm{P}^2\mathrm{O}^5$.

The physical characters of this mineral have not been fully given. It is said to occur in a crystalline mass penetrated by considerable but imperfect faces of cleavage. But they do not furnish evidence sufficiently marked by which to determine the crystalline form. Its color is olive-brown; lustre greasy; gives a greyish-white streak; fracture irregular, in part conchoidal; hardness that of apatite; specific gravity 3·97. B B, it decrepitates, and then melts with ebulition into a bluish-black glass which is attracted by the magnet. It presents the reactions of phosphoric acid, of iron, of manganese and of fluorine. It will probably be admitted as a new species, but as yet no name has been given to it.

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[*] Journ. für pr. Chemie, xvii. 171, or Berzelius' Rapport Annuel, for 1840, p. 138.

BISULPHURET OF MOLYBDENUM.*

Wasserblei, W. Molybdène Sulfuré, H. Bt. Molybdena, J. Rhombohedral Molybdena Glance, M. Molybdenite, *Beudant*. Molybdänglanz, *Leonhard*. Bisulphide of Molybdenum, *Thomson*. Elasmites hexagonus, D.

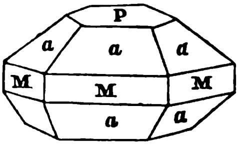
Combination of one atom molybdenum and two atoms sulphur.

			Pennsylvania.
Sulphur	40·0	40·4	39·68
Molybdenum	60·0	59·6	59·42
	100·0 Bucholz.	100·0 Brandes.	99·10 Seybert.

Formula: $Ml\ Sl^2$.

Sp. Gr. 4·4 — 4·7. H. = 1·0 — 1·5.

Shutesbury, Mass.



Color nearly that of fresh cut metallic lead. It occurs massive, with a lamellar structure; and in very flat hexahedral tables, which are readily divisible parallel with their terminal planes; or in the form of a regular Hexahedral prism, which is the primary form. The prisms are more or less deeply replaced on their terminal edges by single planes; and sometimes the edges between *a* of the annexed figure are truncated.† Lustre metallic; opake; sectile; highly flexible; but not elastic; and unctuous to the touch. On paper it leaves traces of a metallic-grey color, and on pottery or porcelain a greenish streak. B B, it gives out sulphurous fumes, which are deposited on the charcoal, but neither fuses nor is reduced. It is soluble with effervescence in nitric acid, but leaves a grey residue; and it deflagrates with nitre.

Molybdena occurs in hexagonal plates in Greenland; and in flat, indistinct, six-sided prisms at Arendal in Norway, and

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* Molybdena, from the Greek, in allusion to its resemblance in color to lead.

† Shepard has figured two crystals of American specimens, and the above figure represents one of them. It would appear that perfect crystalline forms of this species are rarely met with at any of the European localities. None are referred to in Levy's Catalogue of the extensive collection formerly possessed by Mr. Heuland, and now belonging to Mr. Turner. "Schmeisser, however, in the second volume of his Mineralogy, says that he saw crystals of it in the possession of Mr. Rasko, which were six-sided prisms terminated at both ends by six-sided pyramids." [AM. ED.]

Numedahl in Sweden. Generally it is met with in foliated masses, either imbedded in or disseminated through granite, gneiss, syenite, and other primitive rocks; in Bohemia and Saxony with tin; in Silesia, in granite; at Chessy in France, in sienite; in grey granite near Mont Blanc; also in Peru. Many of the Cornish mines produce it in considerable quantity; and in the granite of Caldbeck Fell, in Cumberland, it occurs associated with tungsten, wolfram, and apatite.

In the United States, this mineral is by no means unfrequent in gneiss and granite. It is thus found at Haddam and its vicinity, Conn., in crystals or hexahedral tables; at Brunswick, Me.; Chester, Delaware county, Penn.; in the Highlands, at West Point, and on New York Island, N. Y.; Brimfield, Shutesbury and Fitchburg, Mass., in beautiful radiated groups of crystals; also on the islands in Blue Hill Bay, Me. More recently in the sienite of Sandy Bay, Cape Ann, Mass. At Westmoreland and Landaff, N. H., in regular tabular crystals, associated with crystals of phosphate of lime, and frequently encrusted with yellow oxide of molybdenum.

This species is readily distinguished from graphite by its streak and lustre; by its specific gravity, which is much higher; and by its comportment B B, which is totally dissimilar.

OXIDE OF MOLYBDENUM.

Molybdic Ochre, *Shepard.* Molybdena Ocker, *Karsten.*

Combination of one atom molybdenum and three atoms oxygen; or, in parts, of molybdenum 66·61, oxygen 33·39.

Color yellow of various shades, occasionally greenish; massive; composition impalpable, pulverulent, friable and dull. According to Berzelius, its characters, B B, resemble those of pure *molybdic acid;* but treated with soda it sinks into the charcoal, leaving a residuum of protoxide of iron on the surface. With salt of phosphorus it affords a green glass.

It is found in very minute quantities, incrusting the sulphuret of molybdena, at Numedahl in Sweden, and in other localities of that species.

In the United States, fine specimens of this oxide have been found at Brunswick, Me., and at Westmoreland, N. H.

OXIDE OF TIN.

Zinnstein, W. Etain Oxydé, H. Tinstone, J. Pyramidal Tin Ore, M. Stannolite, *Necker.* Cassitérite, *Beudant.* Stream Tin. Wood Tin. Jovius quadratus, D.

Consists of peroxide of tin, sometimes mixed with small quantities of oxides of iron, manganese, and columbium.

	Cornwall.	Finbo.	Cornwall.
Peroxide of tin	99·00	93·6	96·265
Peroxide of iron	0·25	1·4	3·395
Sesquioxide of manganese	0·00	0·8	
Oxide of columbium	0·00	2·4	0·000
Silica	0·75	0·0	6·750
	100·00 Klaproth.	98·2 Berzelius.	100·410 Thomson.

There can be no doubt that the purest crystals of this mineral consist entirely of peroxide of tin. Formula: Ṣta.

Sp. Gr. 6·4 — 6·9. H. = 6·0 — 7·0.

Common form a quadrangular prism terminated by four-sided pyramids (fig. 4). The primary is an Obtuse octahedron with a square base; the angle over the apex being 112° 10′; and of a plane of one pyramid on the adjoining plane of the other, 67° 50′. It occurs almost transparent, and either colorless or of a yellowish tint; hair-brown or reddish-brown, and translucent; most commonly deep-brown passing into black, and opake; bright-yellow and red colors are produced artificially by exposure to heat. Rarely occurs massive, mostly in crystals coating cavities in veins, or disseminated; also fibrous and granular, reniform and botryoidal (*Wood tin*). Cleavage with some difficulty parallel to the planes of the primary octahedron, viz. with the narrow planes, which appear to replace the pyramidal edges of fig. 3.* Externally the crystals are splendent; fracture uneven or imperfectly conchoidal, with a more or less shining resinous lustre; structure lamellar; streak greyish-white. It gives sparks with the steel, and is brittle. When heated it decrepitates strongly; but is reducible when exposed on charcoal to the continued action of the blowpipe. It is insoluble in acids.

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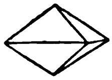

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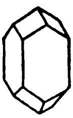

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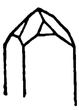

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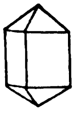

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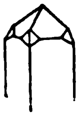

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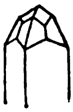

Fig. 1, the primary, an obtuse octahedron; but no crystal has been found of this form; the nearest approach to it is fig. 2, which is prismatic, the planes of the prism arising from the replacement of the lateral solid angles of the primary octahedron by six-sided planes (see Zircon, fig. 1, 2, 3). In fig. 3, the angles formed by the meeting of the terminal (primary) planes with the lateral planes, are each replaced by triangular faces; which are complete in fig. 4 (the form of the common crystal), on which no part of the primary is visible. In fig. 5, each solid angle formed by the meeting of the lateral and terminal planes of a crystal similar to fig. 4, is replaced by two triangular planes; which in fig. 6 are considerably enlarged, and assume another form.

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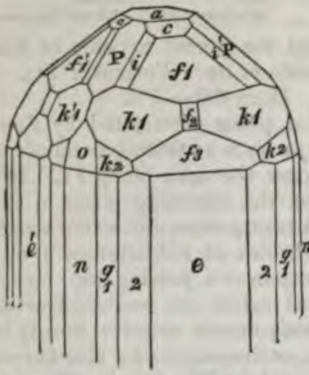
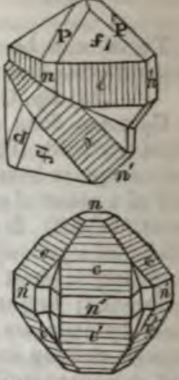
* The primary form of this species is now more usually regarded as a Right square prism, to which it yields cleavage parallel with its lateral faces and both diagonals. The evidence from cleavage, renders the selection a matter somewhat arbitrary. [Am. Ed.]



Macles.



The large figure on the left exhibits a combined view of all the planes hitherto observed on the crystals of oxide of tin; *f* 1 and *f* 1′ are those of the common pyramid; *e* and *e*′ those of the commonly observed prism.

The uppermost of the figures on the right represents the most common macle of the oxide of tin, consisting of equal portions of two similar crystals, the lower of which is turned and attached to the upper; the common plane of their attachment being parallel to the plane P′ of the upper half. The lines down the planes *e* of both halves represent the striæ always observable on the prismatic planes of the crystals, and are here represented in order to show the connection between this and the lower of the two macles, which for the sake of illustration is placed in a different point of view; it will be observed that the lower macle consists only of portions of the *prisms* of crystals attached together, if we except the small planes, which are parts of P′ and *f* 1: only three, or at most four, of these sections are usually to be seen thus attached.

P on P′	133°	30′	*f*1 on *f*1 or *f*1′ on *f*1′ over the summit	92°	55′
P on P over the summit .	112	10			
P or P on *a*	146	2	—— *f*1′	121	40
——— *e*	113	20	—— *f*2.	144	10
——— *f*1	150	45	—— *f*3	142	24
P on *i*	169	30	—— *i*.	161	25
P on *k*1 or *k*′1.	137	20	—— *k*1	154	15
P on *n*.	123	55	—— *h*2.	136	20
—— *o*	140	30	— or *f* 1′ on *n*	119	8
e on *e*′	90	00	*k*1 on *k*1	159	5
e or *e*′ on *n*	135	00	*k*1 on *k*1′	118	10
e on g1	161	38	*k*1 on *e* or *k*1′ on *e*′ . . .	155	25
—— g2	168	45	*n* on g1.	153	25
—— *k*2	171	5	—— g2	146	20
*f*1 on *a*	136	30	*e* on *e*′ (lower macle) . .	90	00
—— *c*	165	56	*e* or *e*′ on *n*′ ditto	135	00
—— *e* or *f*1′ or *e*′	133	32	*n*′ on *n*′ ditto	112	10

Tin belongs almost exclusively to primitive mountains, and is found in veins traversing granite, gneiss, and mica-slate.

On the European continent it is met with abundantly, on both the Bohemian and Saxon sides of the Erzebirge, particularly at Zinnwald and Schlackenwald, where it frequently occurs in macled crystals of considerable magnitude, weighing several pounds. It is also found in Gallicia in Spain; in the granite hill of Puy les Vignes, Haut Vienne, in France; in Greenland; in Sweden; in Brittany, near Roc St. André; in Asia on the east coast of Sumatra, in the island of Banca, and on the peninsula of Malacca; in Mexico; among alluvial deposits in Chili, &c. The granite range which divides Tennasserim from Siam, contains large deposits of tin, and has been explored by an English scientific traveller, Mr. Royle, who has obtained the mineral in fine crystals.

The chief repository, however, of this ore is in Cornwall, where it occurs in veins traversing granite and slate rocks,* accompanied by chlorite, apatite, fluor, topaz, schorl, arsenical pyrites, wolfram, and blende; also disseminated in granite, as in that of St. Michael's Mount. Generally speaking, the Cornish varieties are not of large size, though extremely perfect in form and symmetry, nor do they so often occur macled as those of Bohemia. The tin mines of this country are well known to have been worked at a period anterior even to the Romans. According to De la Beche, the Cornish tin ores sold in 1837, and obtained from about seventy mines, amounted to rising £360,000. The quantity of pure tin made into blocks, was five thousand one hundred and thirty tons. The average annual value has been about £300,000.

In the United States, the first discovery of tin was by Prof. Hitchcock at Goshen, Mass. Prof. Shepard afterwards found a few crystals at Beverly. But this metal was not known to occur *in situ*, until Dr. Jackson discovered it in veins traversing granite and mica slate at Jackson, N. H., where it is associated with wolfram, and various other substances that occur in the tin mines of Cornwall and Saxony. Prof. Wm. B. Rogers, has also discovered this metal, in minute quantities, associated with auriferous quartz, and several other minerals, at some of the gold mines in Virginia. A few very perfect crystals were detected by Mohs in the albite from the tourmaline locality, Chesterfield, Mass.; and more recently by Mr. Teschemacher in very brilliant obtuse octahedrons, formed by the replacements *f* on the primary, with their lateral solid angles replaced by minute planes *n*, the measurements corresponding with the two first and last, in the second column on page 408.

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* These slates do not possess the high antiquity which has been imputed to them, since, both in Cornwall and Devon, they are known to contain numerous fossils; and De la Beche informs us that one of the richest tin mines now worked in Cornwall, is in a fossiliferous rock containing encrinites and corals.—Phil. Mag., united series, xvii. p. 510. We are thus led to suppose that this metal may be discovered more frequently than it has been, by searching for it among the newer rocks. [Am. Ed.]

FIBROUS OXIDE OF TIN. WOOD TIN. Etain oxydé concretionné, H. Contains from 5 to 9 per cent. of iron. This occurs in reniform, globular, and botryoidal masses, or in wedge-shaped pieces, which have arisen from their partial destruction; the surfaces are generally water-worn. It exhibits various shades of brown, which sometimes appear in concentric bands, giving it a ligneous appearance; structure divergingly fibrous in one direction, concentric lamellar in the other; lustre glimmering or silky. It occurs in some of the principal stream works of Cornwall, frequently in masses weighing several pounds. The variety which has received the name of *toad's eye wood tin* consists of minute spherical masses, of a silky lustre, and of alternate hair-brown and yellowish-white colors disposed concentrically; the fibres radiating from a centre. It abounds in the neighborhood of Tregurthy Moor in Cornwall.

STREAM TIN, in quartz rock, as its name indicates, is the alluvial debris of tin veins separated from the deposit of gravel by washing; it consists of detached fragments which occur in many of the low grounds or marshy places of Cornwall; it is sometimes accompanied by grains of native gold; and frequently associated with animal and vegetable remains, such as deer-horns, hazel-nuts, &c. It is a valuable ore of tin. Staniferous gravels, according to Sir Stamford Raffles, now furnish the tin from Banca and the other parts of the Malayan peninsula and islands; and the amount which they supply is supposed to be about three thousand tons per annum.

TANTALIFEROUS OXIDE OF TIN, from Finbo in Sweden, occurs in small grains, imbedded in quartz. It is black, with a shade of red or reddish-grey; lustre metallic; fracture uneven; opake, and hard enough to scratch glass. Specific gravity 6·55. Does not alter B B. One variety afforded Berzelius upwards of 12 per cent. oxide of tantalum.

SPHENE.*

Hemi-Prismatic Titanium Ore, M. Prismatic Titanium-ore, J. Sphen, *Karsten*. Titane Siliceo-Calcaire, H. Rutilus obliquus, D.

Combination of titanic acid, silica, and lime.

	Passau.	Felberthal.	St. Gothard.
Titanic acid	33·0	46·0	33·3
Silica	35.0	26·0	28·0
Lime	33·0	16·0	32·2
Water	0·0	1·0	0·0
	100·0 Klaproth.	99 0 Klaproth.	93·5 Cordier.

The most probable composition of this mineral, as indicated by these analyses, is one atom tersilicate of lime, and one atom titaniate of lime. Formula: $CalS^3+Cal'\dot{T}t$.

Sp. Gr. 3·49 — 3·6. H. = 5·0 — 5·5.

Color grey, yellow, hyacinth-red, and brown, also various shades of green; streak greyish-white; occurs amorphous, and in crystals differing greatly in form; the primary is an Oblique rhombic prism, of which the lateral angles are alternately about 133° 30′ and 46° 30′; cleavage parallel to the faces of this prism, but not easily observed; fracture imperfect conchoidal; translucent on the edges; lustre adamantine, sometimes inclining to resinous. B B, the yellow varieties do not change their color; all the rest become yellow; they slightly intumesce, and fuse on the edges into a dark-colored enamel, and with borax afford a yellowish-green diaphanous glass. With salt of phosphorus it fuses slowly into a globule, which, after a long blast, becomes opaline on cooling; in the reducing flame this globule assumes the amethystine tinge characteristic of titanium. Is soluble in heated muriatic or nitric acid, leaving a siliceous residue; the fragments, when exposed to heat, exhibit a brilliant white phosphorescence.

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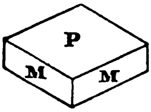
* Sphene, from the Greek, probably in allusion to its crystals being somewhat wedge-shaped.

Primary.



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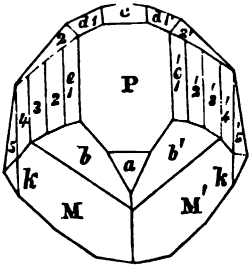

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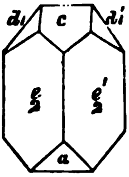

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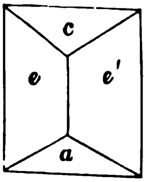

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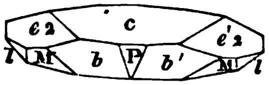
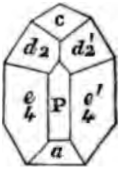


6. Spinthère.



M on M′	133°	30′	M on *l* or M′ on *l*′	151°	20′
P on M or M′	121	50	—— *c*	120	2
—— *a*	159	44	*b* on *b*′	167	00
—— *c*	140	52	*b* or *b* on *c*	139	30
—— *e*2 or *e*2	158	18	*c* on *d*1 or *d*1′	146	44
—— *e*3 or *e*3′	154	20	——— *e*2	145	18
—— *e*4 or *e*4	146	30	——— *e*4	154	52
—— *e*5 or *e*5′	120	2	*d*1 on *d*1′	113	24
M or M′ on *a*	139	30	*d*2 on *d*2′	135	60
— on *b* or M′ on *b*′	124	35	*d*2 on *e*4	152	30
— or M′ on *c*	86	20	*d*1 on *e*2	152	45
— on *e*2 or M′ on *e*2′	119	35	*e*1 on *e*1′	175	42
—— *e*3 ——— *e*3′	116	42	*e*2 on *e*2′	136	50
—— *e*4 ——— *e*5′	138	42	*e*4 on *e*4′	113	40

It occurs chiefly in primitive rocks.

The brown and almost entirely opake varieties of this species occur with augite in beds of iron ore at Arendal in Norway; in a granitic rock at Sartut in Greenland; and with scapolite and tremolite in the limestone quarry of Malsjö in Wermeland, Sweden. The light-colored and frequently transparent crystals, on the other hand, are met with of considerable magnitude, frequently macled in the most fantastic manner, and associated with felspar and chlorite, at Graubinden in the Grisons; on mica slate at St. Gothard; in distinctly pronounced brownish crystals disposed on chlorite at the Val Maggia in Piedmont; of a yellowish-grey color accompanying the rock crystals of Mont Blanc, and elsewhere among the Alps. Small individuals occur in certain syenites, as at Strontian in Argylshire, and Criffle in Galloway. More rarely it appears among volcanic rocks, as at the Laacher See, and Andernach on the Rhine. — *Allan's Manual.*

At Grenville, Lower Canada, sphene occurs associated with table spar, augite and plumbago. The imperfectly crystallized masses are of considerable size, and present broad folia with brilliant cleavage planes. They have been described by Prof. Shepard under the name of *Lederite*, but they are now admitted to be only a variety of sphene.

In the United States, small and nearly jet-black crystals, with a high lustre, accompany the cinnamon stone and egeran at Phippsburg, Me. These crystals are similar to fig. 3, excepting that the planes *a* and *c* replacing the acute and obtuse solid angles, are more extended, as shown in fig. 4. A brownish variety, both crystallized and massive, occurs with scapolite, at the lime quarries in Bolton, Mass.; and Prof. Hitchcock has discovered many very beautifully formed crystals, at Pelham, in the same State, disseminated in gneiss with augite and actynolite. At Rogers' Rock, on Lake George, N. Y., crystals in the form of fig. 3, and with the planes *c* and *a* more extended, are very abundantly distributed in a rock composed of hornblende, felspar and foliated graphite. At Monroe, Orange county, according to Prof. Beck, examples of the primary form, and of the modification represented by fig. 5, occur in limestone, associated with scapolite and zircon. They have a dark chocolate-brown color, and are of considerable size. The primitive limestone at Gouverneur and Hammond, St. Lawrence county, has also furnished many very beautiful crystals of this mineral, of a brownish-black color, and brilliant resinous lustre. Their surfaces are frequently much indented or pitted by small superficial cavities or grooves, as if they had been impressed while in a soft state. In New Jersey, at Franklin and Newton, it occurs in white limestone with spinelle and pyroxene. In Bucks county, Penn., it is associated with table spar and plumbago.

The *Spinthère* of Haüy, found at Isère in France on crystals of carbonate of lime, is only a variety of sphene.

WARWICKITE.

Shepard. (*Amer. Journ. of Science*, xxxiv. 313; xxxvi. 85.)

This mineral was formerly known to the mineralogists of the United States as hypersthene. It occurs at Warwick and Amity, N. Y., imbedded in a highly crystalline white dolomite limestone, with Brucite and yellow idocrase. The following are the results of its analysis, by Prof. Shepard: titanium 64·71, iron 2·14, yttrium 0·80, fluorine 27·33.

These numbers, as viewed by Prof. Shepard, show the mineral to be a compound of twelve atoms difluoride of titanium, and one atom difluoride of iron, as thus expressed by the formula: $12Tt^2Fl+F^2Fl$. Sp. Gr. 3·0 — 3·14. H. = 6·0.

Color hair-brown, to iron-grey. Lustre of the smallest crystals metallic-pearly in a high degree on the cleavage faces, and in other directions only vitreous in moderate degrees. Opake, excepting in very thin fragments, when it is translucent, and transmits a reddish-brown light. Streak dark chocolate-brown. Some large crystals from Amity, N. Y., present characters somewhat different, and in lustre resemble some varieties of rutile. Primary form, an Oblique rhombic prism, M on M = 93° to 94°.[*] In the occurring secondary forms of the mineral, the obtuse lateral edges of the primary are truncated, and its acute edges beveled — the summits being rounded. Cleavage parallel with the longer diagonal perfect. The planes thus obtained are finely striated vertically, and exhibit very distinct, oblique cross cleavages. Fracture uneven. Heated on charcoal, B B, it does not fuse, but simply assumes a lighter shade of color. With borax, it dissolves with effervescence, affording, while hot, a yellow semi-opake glass, which on cooling changes to a pale green and becomes clear. It renders carbonate of soda opake, at the same time imparting to it a dull-yellow tinge. In microcosmic salt, it melts with effervescence, the globule being blood-red while hot, changing to orange-yellow as it cools, and finally becoming reddish-grey and opake. Pulverized and heated in a glass tube, it gives out hydro-fluoric acid.

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[*] This measurement, as given by Dr. Beck, varies from 103° to 105°. The roundish surfaces of the planes P, and the imperfect finish of the secondary planes, have hitherto rendered it impossible to determine accurate measurements of a single crystal. We have thus only an imperfect knowledge of this singularly constituted mineral, the specific character of which is not fully admitted by mineralogists. (Am. Ed.)

ÆSCHYNITE.

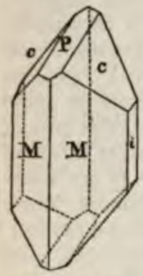
Æschenite, *Brooke.*[*] Melanophæus Mengianus, D.

It contains, by the analysis of Hartwall, the following constituents: titanic acid 56·0, zirconia 20·0, oxide of cerium 15·0, lime 3·8, oxide of iron 2·6, oxide of tin 0·5.

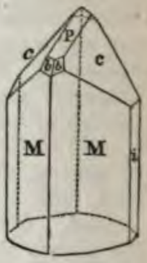
This mineral is a titaniate of zirconia and the three next bases, as thus expressed in the formula by Dr. Thomson: $5Zr\dot{T}t+2Cr\dot{T}t+Cal\dot{T}t+\frac{1}{2}F\dot{T}t$.

Sp. Gr. 5·14 — 5·5. H. = 5·0 — 6·0.

Primary form, according to Descloizeaux, a Right rhombic prism, M on M 129°. Brooke supposed the primary form to be an oblique rhombic prism, and gave the incidence of the lateral faces 127° and 53°. The secondary form, as stated by Phillips, was the primary prism terminated by a summit of four faces. Levy first observed a cleavage perpendicular to the axis of the prism, among the specimens in the Turner collection. The accompanying figures and measurements, have been taken from a paper, by Descloizeaux, in the *Annales des Mines*, ii. p. 349, for 1842.



M on M	129°	00′
M on *i*	115	30
P on *c*	127	00
c on *c*	74	00
M on *c*	109	30
b on *b*	137	38
c on *i*	144	00
c on *b*	126	00



The above angles were determined by direct observation with the common goniometer, and verified by calculation. The differences were very slight, which is remarkable in the case of crystals not measurable with the reflective goniometer, and especially, when the faces, like *b b*, are small and difficult to measure. The incidence of M on M, was determined with the reflective goniometer, these being the only bright planes.

Color dark black, inclining to brownish-yellow when translucent; lustre resinous; streak dark grey or black; fracture imperfectly conchoidal; it is translucent only on the edges, and when in thin fragments. B B, it yields in the matrass some water; on charcoal it intumesces, and becomes yellow; with borax fuses readily into a dark yellow glass, and with salt of phosphorus forms a transparent colorless bead, but with soda is insoluble.

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[*] Edinb. Journ. of Science, new series, iii. p. 28. Phil. Mag. and Annals, x. p. 188.

This mineral occurs in the Ilmen range near Miask in Siberia, imbedded in felspar, and associated with mica and crystals of zircon. The first is an isolated crystal, and the other attached to a gangue of granite and rose colored felspar.

POLYMIGNITE.*

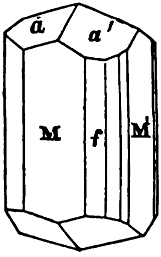
Berzelius. (*Annals of Philosophy*, second series, xii. 117.) Melanophæus rectangulus, D.

Berzelius subjected 10·16 grains of this mineral to analysis and obtained the following results: titanic acid 46·30, zirconia 14·14, yttria 11·50, peroxide of iron 12·20, lime 4·20, sesquioxide of manganese 2·70, peroxide of cerium 5·00.

Rammelsberg, in omitting to give a formula for this mineral, observes, that owing to the small quantity of it employed, and the difficulty of separating the titanic acid from the zirconia, the analysis exhibits a considerable loss, and therefore no calculation can be founded on it.†

Sp. Gr. 4·77 — 4·85. H. = 6·5.

Primary form, according to Rose, a Rhomboidal octahedron, whose dihedral angles are 136° 28′, 116° 22′, and 80° 16′. According to Levy and Brooke, a Right rhombic prism, M on M′ 110° 30′ nearly. Occurs in long thin prismatic crystals, the edges of which are commonly replaced. Color black; opake; lustre imperfect metallic, but brilliant; streak dark brown; traces of cleavage parallel to M and M; fracture perfect conchoidal, presenting, like the surface, a brilliancy almost metallic. Surfaces of the crystals deeply striated longitudinally. *Per se*, it is infusible, and remains unaltered; with borax is soluble with facility into a glass colored yellow by iron, and with salt of phosphorus fuses into a reddish glass. The measurements are, *a* on *a*′ 136° 28′, M on M′ 110° 30′.



Polymignite occurs in crystals sometimes exceeding an inch in length, imbedded in the syenite of Stavern and Fredericks-wärn in Norway. According to Shepard, this mineral has been found at Beverly, Mass.

CERITE.

Rhombohedral Cerium ‡ Ore, M. Cerit, *Hisinger*. Cerium Oxidé Silicifère, H. Cerinstein, W. Cererit, L. Uncleavable Cerium Ore, J. Ceritus rhombohedrus, D.

Peroxide of cerium	68·59	67·0
Silica	18·00	17·0
Peroxide of iron	2·00	2·0
Lime	1·25	2·0
Water and carbonic acid	9·60=09·44 Hisinger.	12·0=100·0 Vauquelin.

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* From πολύς, *much*, and μιγνοω, *I mix*: in allusion to its numerous constituents.

† Handwörterbuch, 2nd part, p. 69.

‡ Cerium, after the planet Ceres.

e numbers, divided by the atomic weights, approach
arly one atom silica, one of peroxide of iron, and one
r, or a simple hydrous silicated peroxide of cerium.
a: $CrS+Aq$. Sp. Gr. 4·9—5·0. H.=5·5.
rose-red or clove-brown, passing into grey; streak
grey; it occurs massive; the fracture splintery and
r less shining; opake, or slightly translucent on the
scratches glass; gives sparks with the steel, and is hard
icultly frangible. B B, on charcoal it splits, but does
e; with borax it melts slowly, and forms in the oxidat-
ne an orange-yellow colored globule, which becomes
colorless on cooling; and in the reducing flame assumes
tint of iron. With salt of phosphorus, in the oxidating
t presents a deep-red glass, which becomes as limpid as
n cooling; and which, in the reducing flame, is colorless.
found only in the copper mine of Bastnaes near Riddar-
in Sweden, where it forms a bed in gneiss, accompany-
per, molybdena, bismuth, mica, and hornblende.

NIFEROUS CERITE.—Laugier describes a variety under this
om the Coromandel coast, of a blackish-brown color, with a vitreous
al fracture. H. equal to that of gadolinite. It contains oxide of
36·0, oxide of iron 19·0, lime 8·0, alumina 6·0, water 11·0, oxide of
se 1·8, silica 19·0, oxide of titanium 8·0. These quantities exceed
·55 parts, an excess occasioned by the protoxide of cerium in the
becoming peroxide in the analysis. It intumesces when heated,
cted upon both by acids and alkalies.

SILICATE OF CERIUM.

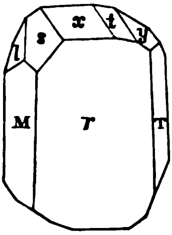
Wollaston. (*Brewster's Journal*, vi. 357.)

Dr. Thomson has rejected his own analysis, and adopted the second by Stromeyer, according to which the mineral consists of simple silicates, (silica 16·51 At., bases 16·68 At.) in the proportions thus shown by the formula: $\mathrm{2AlS+\underline{C}rS+\underline{F}S+CalS}$.

The two last analyses, by Hisinger and Beck, the results of which nearly coincide, give also an equality in the atoms of silica and bases; but, compared with the two first analyses, the silica is differently apportioned among the bases. The formula expressing the constitution of the mineral, based on these two analyses, may be thus stated: $\mathrm{AlS+\underline{F}S+\underline{C}rS+\tfrac{1}{2}CalS}$.

Sp. Gr. 3·5 — 4·0. H. = 6.0.

Color brownish-black; streak greenish-grey. It generally occurs massive, and rarely crystallized in the form of the Doubly oblique prism, its primary, according to Haidinger. They are variously terminated; cleavage indistinct parallel to M and *r*; fracture uneven, passing into small conchoidal, with an imperfect metallic lustre; opake, the thinnest fragments sometimes slightly translucent, and of a yellowish-brown. B B, on charcoal, it fuses readily with effervescence into a black and shining glass; with borax forms a black opake globule, which in the oxidating flame appears blood-red while hot, but becomes deep-yellow on cooling. Gelatinizes readily in nitric acid.*



M on *r*	116° 00′ *c. g.*	— Haidinger.
r on T	129 00	
T on M	115 00	
s on *r*	135 30	
s on *x*	156 45	
t on *x*	164 30	
y on *x*	151 00	
t on *y*	166 30	
y on *r*	109 00	

Allanite is easily distinguished from Gadolinite and orthite, by its difference in specific gravity and hardness; thin fragments of the Gadolinite also are translucent on the edges and of a fine-green color; Allanite is commonly opake, rarely translucent, and of a yellowish-brown.

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* The Allanite, as figured and described in the third edition of this treatise, appears to be the same mineral which has since been distinguished by Haidinger as Fergusonite. This is shown by the analogy in crystalline form. Both minerals were brought from Greenland by Prof. Giesècké, and for a time they seem to have been confounded with each other — Phillips supposing he had given the measurements of a crystal of the same mineral which Dr. Thomson had analyzed. As his measurements, given in the third edition of this treatise, are undoubtedly accurate, they should accompany the figure under the species Fergusonite in this volume. Beudant has followed Phillips in giving the same primary form to Allanite, and has added new secondary forms. [AM. ED.]

Allanite occurs imbedded in granite at Alluk, near the southern extremity of East Greenland, where it was discovered by Professor Giesècké.

The first discovery of this rare mineral in the United States was by Dr. Jackson, in the limestone at Bolton, Mass., accompanying petalite. It has since been found by Prof. Hitchcock, at Athol, Mass., occurring in gneiss. The prisms are rarely two inches long and a quarter of an inch thick, truncated upon the lateral edges, so as in fact to become six-sided prisms; but they present no distinct terminations. The fracture is resinous, and all the external characters of the mineral correspond with Allanite from Greenland.—(*Final Report on Massachusetts*, ii. p. 688.) Prof. Beck (*Report*, p. 441) cites a locality at Munroe, Orange county, N. Y., where, however, it has not presented any regular crystalline form. According to Prof. Shepard, it is found in granitic gneiss, in slender black prismatic crystals, about an inch in length, in the town of North Killingsworth, Conn.

The *cerine* of Berzelius is found associated with cerite, at Bastnaes near Riddarhyttan in Sweden.

TORRELLITE.*

Prof. Renwick. (*Ann. of the Lyceum of Nat. His. of New York*, i. 37.)

Consists of peroxide of cerium 12·32, silica 32·60, protoxide of iron 21 00, alumina 3·68, lime 24 08, water 3·50—Renwick. It is infusible *per se*, but forms with borax a glass which is green while hot, but which becomes colorless on cooling. It effervesces with acid. Color dull vermilion-red; streak rose-red; fracture granular; affects the magnet slightly. Resembles ferruginous jasper.

This mineral has since been examined by Faraday and Children, who discovered in it a notable quantity of oxide of manganese, but failed to detect the presence of oxide of cerium.—(*Ann. of Phil., second series*, ix. 217.) It is possible, however, that the substance examined by these Chemists, may not have been the same with that submitted to analysis by Prof. Renwick, but, on the contrary, a silicate of manganese and iron, allied to Troostite and Fowlerite. But unfortunately the Torrellite of Renwick, is not now recognised by mineralogists, and we are even ignorant of its precise locality. The name is deserving of some better established species than either of those to which it has been applied. (See Columbite.)

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* In honor of Prof. John Torrey, of New York.

ORTHITE.*

Melanophæus acicularis, D.

Combination of silica, alumina, the oxides of iron, cerium, lanthanium, manganese, lime, yttria, magnesia, and a small quantity of water.

	Finbo.	Ytterby.	Gottliebsgang.	Fille-Fjeld.
Protoxide of cerium	17·39	4·98	19·44 and lanthanium	21·43
Silica	36·25	38·24	32·00	34·93
Lime	4·89	5·48	7·84	10·42
Alumina	14·00	8·18	14·80	14·26
Protoxide of iron	11·42	9·06	12·44	14·90
Protoxide of manganese	1·36	0·00	3·40	0·86
Yttria	3·80	29·81	3·44	1·01
Water	8 70	4 59	5·36	0·52
Magnesia, potash and soda	0·00	1·22	0·00	Mg. 0·85
	97·81 Berzelius.	99·93 Berzelius.	99·43 Berzelius.	100·08†

The orthite which most nearly resembles Allanite in composition, as that from Finbo, is, according to Berzelius, a mixture of tersilicates of cerium, alumina and iron. The variety from Ytterby is an orthite mixed with gadolinite. That from Norway, according to Scheerer, differs from Allanite only in the addition of yttria; and he even gives the same formula for the variety from Ytterby. He has endeavored to show that orthite, Allanite and cerite, have together the same expression —$2\dddot{\bar{R}}\,\dddot{Si}+3\dot{R}^3\dddot{Si}$: in which $\dddot{\bar{R}}$ is alumina and peroxide of iron, and $\dot{R}$, on the contrary, represents yttria, protoxide of cerium, oxide of lanthanium, protoxide of iron and of manganese, lime and magnesia; thus differing only as varieties in the kind and quantity of those ingredients which are considered isomorphous.‡

Orthite occurs either massive, or in long, thin acicular crystals, sometimes two feet in length. Primary form undetermined. Color ash-grey, inclining to black; opake; lustre vitreous; streak brownish-grey; fracture conchoidal. It resembles gadolinite, but differs in fusibility. Alone on charcoal, B B, it intumesces, becomes yellowish-brown, and finally fuses to a black blistery glass. In heated acid it gelatinizes; with borax dissolves readily into a globule, which, when hot, is red; when cold, yellow. With fluor spar, shows the reaction of iron, with soda, that of manganese.

Orthite occurs in acicular diverging dark-brown colored prisms sometimes exceeding a foot in length, imbedded in quartz, at Finbo near Fahlun in Sweden; also in black vitreous masses, disseminated through granite, at Skeppsholm, one of the islands of Stockholm. It has likewise been met with at Lindenaes and Fille-Fjeld, in Norway, and was brought from Greenland by Giesècké.

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* From ὀρθὸς, straight. † Scheerer. Rammelsberg's Handwörterbuch, ii. p. 35.

‡ Rammelsberg's Handwörterbuch, ii. p. 36.

According to Berzelius, this mineral is composed of neutral fluates of lime, cerium and yttrium. The American specimen approaches this composition in the proportions of cerium, fluoric acid and yttria, but there is a deficiency in the quantity of lime.

Sp. Gr. 3·4 — 3·5. H. between 4·5 and 7·0.

The color of this mineral is violet, or greyish-red, often mingled in the same specimen. It occurs in amorphous masses, varying from a thin crust to half a pound in weight, and presenting occasional traces of cleavage parallel to the sides of an Oblique rhombic prism, whose lateral planes incline under angles of about 108° 30′. It is opake; lustre glistening; the American specimens pearly. B B, *per se*, it loses its color and becomes white, but does not fuse; but on the addition of gypsum it melts readily into an opake globule. Is soluble with residue in boiling muriatic acid.

The American specimen, as examined by Dr. Jackson, presents the following characters. B B, alone on charcoal, turns yellow and fuses into a greenish slag. With soda, in the oxidating flame, fuses into a yellow-greenish opake enamel. In the reducing flame turns white and remains opake. With borax, it dissolves readily into a glass, which is reddish-yellow while hot, but colorless when cold. With salt of phosphorus, it fuses into an opaline glass, which is yellow when hot, but colorless when cold. In this glass silicic acid is discernible as a white skeleton, or in fine white particles. With gypsum it readily fuses into a greenish-yellow enamel. The powdered mineral, placed in a platinum crucible and moistened with sulphuric acid, gives out hydro-fluoric acid on the application of heat.

The foreign locality of this mineral is at Finbo, near Fahlun in Sweden.

It has recently been discovered in the United States, but we are ignorant of its exact locality. It was found by Prof. Hitchcock in Worcester county, Mass., during his Geological survey of the State. As Allanite occurs in the town of Bolton, and as the scapolite of Boxboro', has recently been found by Dr. Jackson to contain oxide of cerium, it probably came from one of these towns. It was supposed to be fluate of lime, until Prof. Hitchcock inferred its true nature from its resemblance to the foreign mineral, with which the analysis of Dr. C. T. Jackson, has now fully identified it.

It forms a thin layer on quartz and Allanite, associated with silvery-white mica and red garnet; is massive, with traces of crystalline structure. The color like the foreign specimens, but passing into lilac or pink color. Thinnest layers are translucent.

MENGITE. MONAZITE.

Mengite, *Brooke.* (*Phil. Mag.* x. 187.) Monazite, *Breithaupt.* (*Schweigger's Journal,* lv. 301.) Edwardsite, *Shepard.* (*Amer. Jour. of Science,* lxi. 251.)

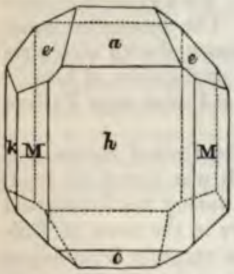
This mineral, first named and described by Breithaupt, has been analyzed by Kersten, who obtained the following results, as shown in the first column :

			Edwardsite.
Peroxide of cerium	26·00		56·53
Oxide of lanthanium	23·40		0·00
Thorina	17·95	Alumina	4·44
Peroxide of tin	2·10	Zirconia	7·77
Protoxide of manganese	1·86	Silica	3·33
Lime	1·68		0·00
Phosphoric acid	28·50		26·66
	101·49*		98·73 Shepard.†

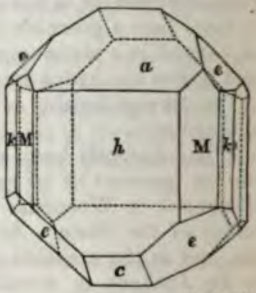
Sp. Gr. 4·924. H. = 5·0.‡

Primary form, according to Descloizeaux, an Oblique rhombic prism, M on M 92° 30′, P on M 100° 25′ 13″. Brooke, from the measurement of a crystal whose planes were too dull for permitting the use of the reflective goniometer, gave the inclination of M on M, nearly, 95° 30′, P on M 100°.§ The following figure and measurements of monazite, are from a paper by M. Descloizeaux, on the primitive and secondary form of this mineral, in the *Ann. des Mines* for 1842, tome ii. p. 364. The measurements were determined by the reflective goniometer, and verified by calculation.

Monazite.



Edwardsite.



M on M	92° 30′	*c* on *h*	126° 00′
M on *k*	133 30	*e* on *k*	131 00
M on *h*	136 30	*e* on *a*	127 00
k on *h*	90 00	*e* on *c*	117 00
a on *h*	141 05		

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* Poggendorf's Annalen, xlvii. 385. It contained besides traces of titanic acid and potash.

† Amer. Jour. of Science, xxxii. 162.

‡ Edwardsite, according to Shepard — Sp. Gr. 4·6. H. = 4·5.

§ Brooke first correctly referred the primary form of this mineral to the oblique rhombic system. The name which he originally bestowed upon it, in honor of its discoverer, should have claimed the preference, but Breithaupt's has generally been adopted. [Am. Ed.]

The secondary dominant form of monazite, according to Descloizeaux, is a square prism flattened on one of its faces, and terminated at each extremity by an irregular tetrahedral summit. The planes M, are always very small, and in some crystals entirely wanting. The faces of the crystals are not equally brilliant, those lettered *e*, especially, having a greasy look, which prevented a rigid measuring with the reflective goniometer; and for this reason the incidences of some of the faces measured, with those calculated, did not exactly agree.

Color hyacinth or brick-red; translucent on the edges; lustre vitreous; streak white. Heated to redness in a glass tube, it suffers no change. In the strongest heat of the blowpipe, it only melts upon the edges, when it becomes greenish-yellow. Treated with soda or borax in the reducing flame, it dissolves with effervescence into a light yellowish opake mass. Dissolved in salt of phosphorus, the globule is yellow while warm, but on cooling, becomes yellowish-green and opake. The American variety exhibits very nearly the same character, B B, but differs in its behaviour with acids, being slightly effected by Aqua Regia, while the monazite, according to Kersten, is decomposed by chlorhydric acid with the evolution of chlorine.

The crystals of Edwardsite were first described by Prof. Shepard, as oblique rhombic prisms (M on M 95°, P on M 100°) replaced on their acute lateral edges by single planes inclining to the adjacent lateral faces under 137° 30′*; and the very minute crystals have their summits surmounted by four-sided pyramids, whose faces correspond to the lateral edges of the prism; in others, the replacements of the acute lateral edges is so deep as to cause them to assume a flattened shape. Cleavage, generally indistinct parallel to the oblique terminal plane, but very perfect parallel to the longer diagonal. They closely agree with monazite in the measurement of their angles, as since determined with the reflective goniometer by Prof. Shepard, and calculated by Dana. M on *h* in Edwardsite gave 136° 30′, *a* on *h* 140° 10′, *c* on *h* 126° 25′, *e* on *k* 131° 22′. In their ordinary occurring forms, and in all their external characters, there is also a very close resemblance to monazite.

Monazite is found in the mountains about Ilmensee in Siberia, associated with flesh-red felspar in granite; it was first described by Brooke under the name of Mengite, in honor of *M. Mengé*, by whom it was discovered.

Edwardsite occurs at Norwich, Conn., at the Falls of the

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* These were only approximate measurements obtained on an imperfect crystal with the common goniometer, and have since been corrected by Prof. Shepard.

Yantic, in small brownish or hyacinthine-red crystals, in a red felspathic granite accompanied by Sillimanite. The crystals are rarely above a quarter of an inch in length, and one-sixth of an inch in thickness. A single crystal was also noticed by Prof. Shepard at the locality of Sillimanite in Chester, Conn.[*]

Edwardsite was supposed to be a new species by Prof. Shepard; but Prof. G. Rose, from a careful examination of this mineral, having been led to regard it as identical with monazite,[†] Prof. Shepard has instituted a new examination of its characters, and has fully satisfied himself of the identity of the two minerals. He finds the oxide of cerium to be accompanied by oxide of lanthanium, (a substance unknown to him when he made his first analysis,) as well as by thorina and oxide of tin, which at first escaped his notice. As the tin, from its minuteness, is evidently accidental, it is not a little remarkable that Rose should also find it in the American mineral.

EREMITE.—This mineral, the name of which is derived from ἐρημία, solitude, in allusion to its rare occurrence, was first noticed by Prof. Shephard, in his *Report on the Geological Survey of Connecticut*, and afterwards in a paper in the *Amer. Jour. of Science*, xxxii. 341, where he has described its crystallographical and general physical characters, under the designation of a new species. In vol. xxxiii. of the *Amer. Journal of Science*, J. D. Dana has given the drawings of three crystals of this mineral, and recorded their angular measurements. His results at first led him to coincide in the opinion of Prof. Shepard; but from a subsequent examination and comparison of the eremite with monazite, as to its hardness, color, lustre and cleavage, as well as from its agreement with the angles of monazite, as stated by Descloizeaux, he now regards these two minerals as identical. The incidences, as determined by Dana, are M on *h* 136° 35′, *a* on *h* 140° 40′, *c* on *h* 126° 8′, *e* on *k* 131° 52′.[‡]—*Amer Jour. of Science*, xlv. 402. As described by Prof. Shepard, the primary form is supposed to be a Right oblique-angled prism, M on T 140° 30′—the surfaces of these planes being smooth and brilliant. Fracture conchoidal to uneven; lustre resinous to vitreous; color between clove and yellowish-brown; semi-transparent; streak paler than the color. B B, it instantly becomes transparent and colorless, but does not suffer the slightest fusion, even in very thin fragments. Heated with carbonate of soda, on a platina support, an opake white mass was obtained, stained in a single spot of cinnamon brown color. With borax, fuses slowly, attended by a slight effervescence, and yields a transparent amber-yellow globule, which, by flaming, becomes paler and milky in its clearness. In a glass tube, heated with sulphuric acid, it shows the presence of fluoric acid.

This mineral was discovered by Mr. T. R. Dutton, imbedded in albitic granite, and accompanied by apatite, at Watertown, Conn. The crystals are small, the largest not over one-fifth of an inch long; the others varying from one-sixteenth to one-twentieth of an inch.

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[*] Report on the Geological Survey of Connecticut, p. 123. Amer. Jour. of Science, lxi. 254.

[†] Pogg. Ann., No. 1, 1840.

[‡] Compare these with the corresponding inclinations of Mengite and Edwardsite.

NEUTRAL FLUATE OF CERIUM.

Deuto-fluate of Cerium. Flucerine, *Beudant.* Spanialus hexagonus, D.

Consists, according to Berzelius, of per and protoxide of cerium 82·24, yttria 1·12, fluoric acid 16·24.

The per and protoxides of cerium, according to Berzelius, exist in this mineral in the proportions of two atoms of the former to one of the latter; whence, as it is a simple fluate of cerium, it consists of one atom fluated protoxide, and two atoms fluated peroxide of cerium. Formula: $\underline{C}r\dot{F}l+\underset{\cdot}{C}r2\dot{F}l$.

Sp. Gr. 4·7. H. about 4·0.

Occurs in six-sided prisms, in plates, and in amorphous masses, of a reddish or wax-yellow color. Dull; translucent in extremely thin fragments; and having an uneven fracture. B B, on charcoal it does not fuse, but merely becomes slightly brown; with borax and salt of phosphorus, it gives in the oxidating flame, a red or orange colored globule, which becomes pale on cooling; in the reducing flame it loses its color entirely. Heated in a tube it corrodes the glass.

This mineral has hitherto only been found at Finbo and Broddbo near Fahlun in Sweden, in very small quantities; it occurs imbedded in granite, and associated with pyrophysalite, orthite, &c.

Double Fluate of Cerium and Yttria.—This is an earthy mineral found at Finbo in Sweden; it is much more common than the preceding, but its size seldom exceeds that of a pea. It is usually of a pale-red color, but occurs deep-red, yellow, and even white. It is very soft, and may easily be scratched by the nail. According to Berzelius, it is a mechanical mixture of the fluate of yttria, with fluate of cerium, and silica. It presents nearly the same re-actions as the Neutral Fluate.

SUBSESQUIFLUATE OF CERIUM.

Basi-cerine, *Beudant.* Spanialus dodecahedrus, D.

This is the sub-fluate of cerium, or fluate of cerium with excess of base, of Berzelius, and is composed, according to his analysis, of peroxide of cerium 84·20, fluoric acid 10·85, water 4·95. These numbers give very nearly one and a half atom peroxide of iron, to every atom of fluoric acid, united with a half atom of water. It is therefore a hydrous subsesquifluated peroxide of cerium, as described by Dr. Thomson. Formula: $\underset{\cdot}{C}r^{1\frac{1}{2}}\dot{F}l+\frac{1}{2}Aq$.

This mineral differs from the above in containing rather a larger proportion of the oxide of cerium — in the absence of yttria — and in the presence of a variable quantity of water. It possesses considerable resemblance to porcelain-jasper. Color yellow; with occasional slight traces of crystallization, approaching to rhombic dodecahedrons. B B, on charcoal it is infusible, becomes black at an incipient redness, but on cooling, assumes successively dark-brown, red, and orange tints.

It occurs in minute quantities, accompanying Allanite, at Bastnaes near Riddarhyttan in Sweden.

Dr. Jackson has recently discovered this substance encrusting the pink scapolite from Boxboro', Mass., and also contained in the small cavities of the scapolite rock. He regards it as a *Hydrated Basic-fluoride of Cerium.* It is of a fine sulphur-yellow color, and pulverulent, or in minute yellow scales. B B, it is infusible, and turns dark brown at a red heat. With borax, it forms a glass which is orange colored while hot, and nearly colorless, or of a delicate green tinge when cold. It forms a lemon-yellow solution in chlorohydric acid, from which crystals of sulphate of potash, precipitate a white powder, which is sulphate of cerium and potash.

PITCH-BLENDE.

Peche-blende, Pecherz, W. Urane Oxydulé, H. Uranpecherz, L. Uncleavable Uranium Ore, J. M. Uranius amorphous, D.

Protoxide of uranium	86·5	84·52
Protoxide of iron	2·5	8·24
Silica	5·0	2·02
Sulphuret of lead	6·0	4·20
Oxide of cobalt	0·0	1·42
	100·0 Klaproth.	100·46 Pfaff.

The several analyses which have been made of this mineral rather indicate it to be a mechanical mixture, than a chemical compound. It has been regarded by some as a silicate of uranium; but the ratio of the silica to the oxide of uranium, differs so much as to render this view of it very improbable.

Sp. Gr. 6·05 — 7·05. H. = 5·5.

Color greyish-black, brownish-black, and iron-black; and occurs globular, reniform, massive, disseminated, and pulverulent; form and crystalline structure unknown; fracture uneven, or small conchoidal; lustre dull or imperfect metallic; in the former case frequently presenting iridescent colors superficially; it is opake; very brittle, but sometimes scratches glass. *Per se*, it is infusible B B; but with borax it yields a deep yellow colored glass, which becomes of a dirty green in the reducing flame, and when saturated to a certain point, turns black on flaming. If reduced to powder it is slowly soluble in nitric acid, with effervescence and a disengagement of nitrous gas. Does not act on the magnet.

It occurs in botryoidal masses, accompanying various ores of silver and lead, at Marienberg, Schneeberg, and Johanngeorgenstadt in Saxony; at Joachimsthal and Przibram in Bohemia; at Rezbanya in Hungary; and with uranite in several of the Cornish mines. It is a valuable ore to the porcelain painter, yielding a fine orange color in the enamelling fire, and a black one in that in which the porcelain itself is baked. — *Allan's Manual.*

URANITE.

CALCAREO-PHOSPHATE OF URANIUM.

Phosphate of Uranium. Uran Glimmer, W. Urane Oxidé, H. Urane Micacé, Br. Uran-Mica, J. Pyramidal Euchlore Mica, M. Calcareo-phosphate of Uranium. *Thomson.* Uranulus quadratus, D.

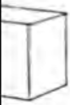
Combination of phosphoric acid, lime, oxide of uranium, and water, with other accidental mixtures.

	Autun.	Autun.
Peroxide of uranium	59·37	55·0
Phosphoric acid	14·63	14·5
Lime	5·66	4·6
Magnesia and oxide of manganese	0·19	0·0
Silica and oxide of iron	2·45	3·0
Barytes	1·51	0·0
Water	14·90	21·0
Fluoric acid and ammonia	traces	0·0
	99·17 Berzelius.	98·1 Laugier.

The constitution of this species, as deduced from the first analysis, is one and a half atom lime, two atoms peroxide of uranium, three atoms phosphoric acid, and twelve atoms water. Consequently, the phosphoric acid is combined with peroxide of uranium as a simple phosphate, and with the lime as a subsesquiphosphate, as thus expressed by the formula: $2\underset{\cdot}{U}\dot{P}h+Cal^{1\frac{1}{2}}+\dot{P}h+12Aq$.

Sp. Gr. 3·12. H. = 2·25.

Color lemon-yellow, the same crystal being sometimes yellow at one end, green at the other; it becomes brownish and dull by decomposition. It is found crystallized in quadrangular prisms, in four-, six-, and eight-sided tables, rarely in acute and obtuse octahedrons; the structure is lamellar, and it is mechanically divisible parallel to all, and with remarkable ease to the terminal planes (P) of a Right square prism — the form of the primary crystal. Transparent, translucent, or opake; the lustre shining, pearly upon the face P; it yields easily to the knife, and is brittle. It decrepitates violently on charcoal B B, and loses about 33 per cent. by ignition; with borax and salt of phosphorus, the glass obtained in the reducing flame remains green after cooling; with soda the assay yields no metallic particles. Its solution in nitric acid is yellow, and in ammonia white.



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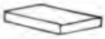

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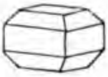

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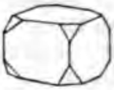

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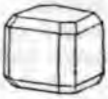
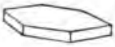
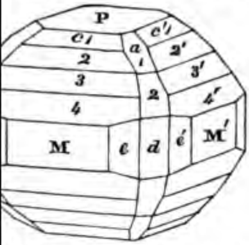




3.

1, the primary ; a right square prism. Fig. 2, a tabular crystal of rangular form ; these occur of various lengths. Fig. 3 ; in this the ngles of the preceding are replaced, producing a six-sided tabular ; these are commonly very long. Fig. 4 ; in this all the terminal of the quadrangular prism are replaced, tending to produce an octa-, which sometimes occurs. In fig. 5, the solid angles of the prism are replaced by triangular planes. In fig. 6, all the edges and ngles of the quadrangular prism are replaced.



P on M or M′	90°	00′	*c. g.*
M on M′	90	00	
P on *c*1 or *c*1′	145	32	
—— *c*2 or *c*2′	140	40	
—— *c*3 or *c*3′	137	10	
—— *c*4 or *c*4′	111	50	
—— *a*2	134	00	
*c*4 on *c*4′	97	32	

occurs in veins in granite at St. Symphorien near Autun, Yrieux near Limoges in France, and in several places in

	Cornwall.	Cornwall.
Peroxide of uranium	60·25	60·0
Phosphoric acid	15·56	16·0
Oxide of copper	8·44	9·0
Water	15·05	14·5
Stony matter	0·70	0·5
	100·00 Berzelius.	100·0 R. Phillips.

These results lead to the same atomic composition with the last described species, excepting that oxide of copper is substituted for lime. The formula is, therefore, thus stated; $2\underset{\cdot}{U}\dot{P}h+\underset{\cdot}{C}p^{1\frac{1}{2}}Ph+12Aq$.

Sp. Gr. 3·33. H. = 2·0 — 2·5.

This species corresponds with the preceding in crystalline form, and in all other points except in the following.—Its color is emerald-green or grass-green; its solution in ammonia is blue; B B, with borax and salt of phosphorus, the glass obtained in the reducing flame becomes, on cooling, red and opake. With soda the chalcolite of Cornwall is reduced into white metallic grains.

Beautiful varieties of this species have been found in Cornwall, particularly in the veins of Tin Croft Mine, and Huel Buller near Redruth, with red copper and arseniate of iron in Huel Gorland and Huel Unity, at the Tolcarn mine, and in Gunnislake mine near Callington. This species might sometimes be confounded with green mica, but the laminæ of mica are flexible and elastic, while those of uranium are brittle, and do not bend; mica, moreover, is not soluble in nitric acid.*

CARBONATE OF URANIUM.

Uran-Bloom, Uran-Blüthe, *Zippe*. Uraconise, *Beudant*. Uranalus ochraceus, D.

In crystalline flakes of a small size, devoid of distinct form. Color bright yellow, between lemon- and sulphur-yellow; opake, with little lustre. When slightly heated B B, its color becomes orange-yellow. It is soluble with effervescence in acid, yielding a yellow solution, which affords a brown precipitate with prussiate of potash, thus demonstrating it to be a carbonate of uranium.

Professor Zippe of Prague, distinguished this substance from uran-ochre, and the yellow oxide of uranium, chiefly from its want of lustre and more brilliant color. It occurs in silver veins at Joachimsthal in Bohemia, with pitch-blende, uran-ochre, and pharmacolite; and apparently is derived from the decomposition of the pitch-blende, on which it commonly forms a coating.

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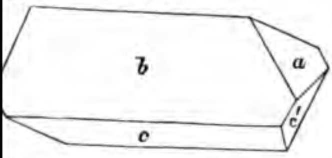
* The crystals of this species lose their transparency, and assume a yellowish-green color, at the temperature even of 80°; a change probably owing to the loss of a portion of their essentially combined water. [AM. ED.]

JOHANNITE.†

ulfaté, *Necker.* Johannite, *Haidinger.* Uran Vitriol, *John* Sulfate Vert d'Urane, *Beudant.* Vitriolum Uranicum, D.

ous sulphate of uranium, mixed with sulphate of copper.
Sp. Gr. 3·19. H. = 2·0 — 2·5.

mary form an Oblique rhombic prism. Secondary, acng to Haidinger,



a on *a'* . . .	111	00'
a on *b* . . .	118	00
a' on *c* . . .	87	28
b on *c*	128	32

very minute crystals. Color deep grass-green; translu lustre vitreous; streak pale siskin-green; taste slightly ; cleavage traces parallel to *a*, and to a face which beve edge between *b* and *c*. Fracture imperfect conchoidal. lly soluble in water. Heated in the matrass it yields moisture, leaving a dark blackish-brown mass. Fused charcoal with soda, and then laid on a piece of silver noistened, it blackens the metallic surface. In the reg flame with soda, a bead of copper is obtained. With it forms a fine green glass, as well in the oxidating as in educing flame; in the latter it becomes red and opake on ng, exhibiting the presence of oxide of copper. With f phosphorus only green colors are produced, that of the

These results are very discordant, and it is not improbable that the mineral is a mechanical mixture of sulphuret of tin, with iron and copper pyrites. Berzelius and Beudant from the last analysis, have stated the formula thus: $StaSl+Cp^2Sl+FSl^2$.

Sp. Gr. 4·35 — 4·76. H. = 4·0.

Massive; of a steel-grey color when pure, often yellowish from an admixture of copper pyrites; and these colors are sometimes intermingled in the same specimen, imparting to the mass, somewhat the aspect of bell-metal, whence *bell-metal ore;* fracture granular and uneven, passing into flat conchoidal, with a shining metallic lustre; opake and brittle. B B, sulphur is driven off, after which it fuses readily into a black scoria. It is soluble in nitro-muriatic acid, with the exception of the sulphur, which is precipitated.

It occurs only in Cornwall, and that principally at Huel Rock in the parish of St. Agnes, accompanying blende, pyrites, and other minerals. Crystals have been noticed apparently in the form of regular hexahedrons, and traces of cleavage seemed to be parallel with this form, and at the same time parallel to the dodecahedron.

OXIDE OF TUNGSTEN.

Native Yellow Oxide of Tungsten, *Silliman*. Tungstic Ochre, *Shepard*.

Soft. Sp. Gr. 6·0.

This mineral varies in color from orange- or chrome-yellow to yellowish-grey. It occurs massive; composition impalpable; earthy and pulverulent; is inodorous; tasteless; assumes a greenish hue under the blowpipe; is insoluble in acids, but by digestion in nitric acid, the powder, which is greyish, assumes a brilliant yellow color, and would probably afford a fine pigment. It is readily soluble in warm liquid ammonia; and is precipitated white by acids, the precipitate by standing, re-acquiring a yellow color.

For our earliest knowledge of this mineral we are indebted to Prof. Silliman, by whom it was discovered about the year 1820.* It has not been analyzed, but its analogy to the yellow oxide as artificially prepared, leads us to suppose it to be pure tungstic acid, consisting according to Berzelius, of oxygen 20·23, tungsten 79·77.

It occurs in quartz, associated with wolfram and tungsten, in minute veins or thin coatings, at Lane's mine, Monroe county, Conn.

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* Amer. Journ. of Science, iv. 52.

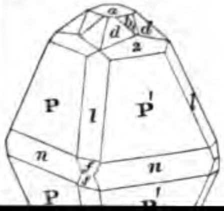
ANATASE.*

dal Titanium Ore, M. Oktaedrite, W. Titane Anatase, H. Bt. Octahedrite, J.
Rutilus pyramidalis, D.

is supposed to consist of nearly pure titanic acid — Ṫt.

Sp. Gr. 3·85. H. = 5·5 — 6·0.

is mineral represents various shades of brown, indigo- or steel-grey; by transmitted light it is greenish-yellow. ccurs in small crystals, having the general form of an e octahedron with equal and similar isosceles triangular , which is the form of the primary crystal; the crystals it the planes of several modifications; structure lamellar; age both parallel to the faces of the octahedron, and per- icular to the axis; lustre of the fragments splendent and antine; varies from semi-transparent to opake; streak ; and is brittle. When heated, it exhibits a reddish- w phosphorescent light; and acquires resinous electricity iction. B B, it is infusible without addition; with soda it s a dull yellow globule, which becomes white on cooling.



P on P, or P′ on P′ .	136°	47′
P on P′ or P on P′ .	98	5
P or P′ on *a*	111	17
P′ on *b*1	131	22
—— *d* or *d*	132	5
b on *a*	160	24
—— *d*	166	30

Occurs in a pulverulent state, and of a green color more or less intense, at Ecouchets in Burgundy. B B, it is infusible, but changes to a lighter green. With borax it forms a fine green-colored globule. It is mentioned as occurring in the Isle of Unst in Shetland, and in serpentine rocks in Savoy and Piedmont.

NATIVE BISMUTH.

Octahedral Bismuth, J. M. Godiegen Bismuth, W. Bismuth Natif, H. Bismutum octahedrum, D.

This is the pure metal, Bs, occasionally mixed with small quantities of arsenic and sulphur.

Sp. Gr. 9·6—9·8. H. =2·0—2·0.

Its color is silver-white tinged with red, presenting generally an external tarnish; it occurs feathery, reticulated, amorphous, and crystallized in the form of the Regular octahedron, which is its primary form; structure lamellar, with joints parallel to the planes of the octahedron, and probably also in other directions; lustre metallic; soft, sectile, and not very frangible. When cold, brittle; but, on being heated, may be hammered into plates. Fuses readily at the comparatively low temperature of 476°. It is soluble in nitric acid, but the solution yields a white precipitate if diluted. After fusion it crystallizes, on slow cooling, in regular cubes. On friction it presents resinous electricity. When placed on live coal, or exposed to the candle, it melts; B B, it is volatilized in the form of white vapor, which forms a yellow coating on the charcoal, emitting at the same time an arsenical odor, from an accidental admixture of arsenic.

Bismuth chiefly occurs in the veins of primitive mountains, accompanying various ores of silver, cobalt, lead, and zinc.

Its principal localities are Johanngeorgenstadt and Schneeberg in Saxony, Joachimsthal in Bohemia; Modum in Norway; Transylvania, Suabia, France, and Sweden.

In Cornwall it occurs in feathery masses, with arsenical cobalt, at Huel Sparnon, near Bedruth; and in Herland mine near St. Ives. At Schneeberg it forms arborescent delineations disseminated in brown jasper, which appear very distinctly when the mass is cut into slabs and polished.

Its great fusibility renders bismuth a useful compound in the formation of several metallic alloys, as in the fabrication of printers' types, pewter, and solder.

The only locality of this metal at present known in the

f States, in Monroe, Conn., where it occurs dissemina-
n quartz with iron pyrites, wolfram, and galena. Prof.
ns found a single specimen in Essex county, N. Y.

SULPHURET OF BISMUTH.

glanz, W. Bismuth Sulfuré, H. Br. Bismuth Glance, J. Prismatic Bismuth Glance, M. Bismuthine, Beudant. Bismutine octangulus, D.

mbination of sulphur and bismuth in the following pro-
ns:

	Riddarhyttan.
Bismuth	80·98
Sulphur	18·72
	99·70 H. Rose.

e a simple sulphuret of bismuth. Formula: BsSl.

Sp. Gr. 6·5. H. = 2·0 — 2·5.

ur between tin-white and lead-grey, but is sometimes
ish-white, with a metallic lustre; it occurs in acicular
, and in minute crystals deeply striated longitudinally,
ities; also massive, in which case it presents sometimes
ted structure like galena, sometimes a fibrous one like
ony: cleavage parallel to the planes P and *f* of the fol-
g figure, and at right angles to the latter; the principal
rallel to *f*. The artificial crystals of sulphuret of bis-
according to W. Phillips, are rhombic prisms of 91° and
It is soft and brittle. It melts in the flame of a candle;
B. is for the most part volatilized with a sulphureous

ish-white color disseminated in jasper, at Botallack near the Land's End; massive, imbedded in limestone, at Johanngeorgenstadt; foliated and granular at Magurka in Hungary; with cerite at Bastnaes in Sweden; and elsewhere. According to Prof. Shepard, sulphuret of bismuth in very small quantity, has been detected in the granite vein which contains chrysoberyl at Haddam, Conn.

CUPREOUS BISMUTH.

Cupriferous Sulphuret of Bismuth. Kupferwismutherz, W. Bismuth Sulfuré Cuprifère, *Necker*. Cuivre Sulfuré Bismutifère, *Berzelius*.

Combination of sulphuret of copper and sulphuret of bismuth. Sulphur 12·58, bismuth 47·24, copper 34·66. — *Klaproth*. It does not appear that these constituents are united in atomic proportions.

It is of a lead-grey, steel-grey, or tin-white color, speedily acquiring a yellowish or reddish tarnish from exposure; and occurs very indistinctly crystallized, massive, disseminated, and acicular; fracture small grained and uneven; sectile; lustre metallic; streak white. Partly soluble in nitric acid, the sulphur being left.

It occurs in certain mines near Wittichen in Furstenberg, in veins traversing granite, with barytes, native bismuth, and copper pyrites.

NEEDLE ORE.

Acicular Bismuth Glance, J. Plumbo-Cupriferous Sulphuret of Bismuth. Nadelerz, W. Bismuth Sulfuré Plumbo Cuprifère, H. Bismites acicularis, D.

Composed essentially of sulphurets of bismuth, lead and copper.

	Ekatherineburg.	Ekatherineburg.
Bismuth	43·20	36·45
Sulphur	11·58	16·61
Lead	24·32	36·05
Copper	12·10	10·59
Nickel	1·58	0·00
Tellurium	1·32	0·00
	94·10 John.	99·77 Frick.

The loss of about 6 per cent. in the first analysis, must destroy all confidence in the formula which has been founded upon it. Rammelsberg thus gives the formula answering to the last. $\overset{\prime}{C}u\overset{\prime}{B}+2\overset{\prime}{P}b\overset{\prime}{B}i$.

Sp. Gr. 6·1 — 6·15. H. = 2·0 — 2·5.

Occurs in imbedded acicular four- or six-sided prisms, indistinctly terminated, and striated longitudinally; structure lamellar; cleavage parallel to the axis of the prism; the cross fracture small grained and uneven, with a shining metallic lustre. Color, when first broken, steel-grey or blackish lead-grey, soon acquiring a yellowish tarnish. B B, it partly volatilizes and deposits on the charcoal a yellow powder, after which there remains a red globule, enclosing a grain of metallic lead. Soluble with brisk effervescence, and the disengagement of red fumes in nitric acid, which it colors green; ammonia precipitates the copper of this solution.

It has only been found near Ekatherineburg in Siberia, imbedded in quartz, and accompanying galena and gold.

OXIDE OF BISMUTH.

Bismuth Ochre. Wismuthocher, W. Bismuth Oxydé, H. Bt. Bismutalus ochraceus, D.

This mineral was supposed to be pure oxide of bismuth, but an analysis by Lampadius shows it to contain besides oxide of iron, carbonic acid and water. But these are not in atomic combination, so that the mineral, when pure, is $\underset{\cdot}{\mathrm{B}}\mathrm{s}$, consisting of one atom oxygen, and one atom bismuth.

Sp. Gr. 4·36.

Color straw-yellow or yellowish-grey; occurs massive and disseminated; the structure sometimes lamellar, with a shining lustre; sometimes fine-grained or earthy, and dull; it is opake, soft, and often friable. On charcoal, B B, it is easily reduced to the metallic state. In nitric acid it is soluble, the solution throwing down a white precipitate on the addition of water.

It has been found in small quantities, upon the ores of bismuth, cobalt, and nickel, at Schneeberg and Johanngeorgenstadt in Saxony, at Joachimstal in Bohemia, and with plumbo-cupriferous sulphuret of bismuth and native gold at Beresof in Siberia. Prof. Wm. B. Rogers has discovered small portions of oxide of bismuth at the gold mines in Virginia.

CARBONATE OF BISMUTH.

This substance was mentioned in the third edition of this work, but was omitted by Allan, probably from its existence being doubtful. We have no perfect analysis of it, but Mr. Gregor found it to consist principally of carbonic acid and bismuth, mixed with oxide of iron and earthy matter. It has the appearance of an earthy substance, and somewhat resembles steatite. It was first noticed in *Sowerby's English Mineralogy*. It may prove to be bismuth ochre. It was found at St. Agnes in Cornwall. Breithaupt has more recently (*Pogg.*

Ann. liii. 627) described a carbonated bismuth from the iron mine of Arme Hülfe near Hirschberg in Reusse, where it is found with compact hydrate of iron, and is accompanied by native bismuth, sulphuret of bismuth, copper pyrites, &c. It is massive and sometimes forms small acicular crystals. It is yellow or greenish; is opake, excepting on the edges; has a feeble vitreous lustre; its fracture is conchoidal and earthy; very brittle; hardness between 5 to 5½. Sp. Gr. about 7.

SILICATE OF BISMUTH.

Bismuth-Blende, *Breithaupt.* Arsenical Bismuth. Arsenik-Wismuth, W. Kiesel-Wismuth, L. Bismutulus dodecahedrus, D.

This mineral was first described and named by Breithaupt.* It was afterwards analyzed by Kersten, with the following results:

	Schneeberg.
Oxide of bismuth	69·38
Silica	22·23
Oxide of iron	2·40
Oxide of manganese	0·30
Phosphoric acid	3·31
Water	1·01
	98·63

The atoms of oxide of bismuth are to those of silica, very nearly as 1 to 1·5, whence the formula is, $\underset{.}{B}sS^{1\frac{1}{2}}$. It is therefore a sesquisilicate of bismuth. This supposes the phosphoric acid and oxide of iron to be accidental.

Sp. Gr. 5·9 — 6·0. H. = 3·5 — 4·0.

In minute dodecahedral crystals, presenting according to Breithaupt, cleavages parallel to the faces of the Rhombic dodecahedron, its primary form. It occurs also in tetrahedrons, and in implanted globular masses. Color dark hair-brown or wax-yellow; streak yellowish-grey; semi-transparent or opake; lustre resinous or adamantine; fracture uneven; cleavage parallel to the faces of the dodecahedron, imperfect; rather brittle. Decrepitates briskly B B, emits an arsenical odor, and is ultimately converted into a glass which effervesces with borax.

This species accompanies cobalt and native bismuth, at Schneeberg in Saxony; its general appearance is that of implanted globules, which rarely exceed the size of a pin-head, and are of a dark-brown color.

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* Poggendorf's Annalen, ix. 275

TELLURET OF BISMUTH.

a Silver, J. and A. Molybdan Silber, *Werner.* Tellur-Wismuth, *Leonhard.* , *Beudant.* Rhombohedral Bismuth Glance, M. Bismites rhombohedrus, D.

posed of tellurium, bismuth, and selenium, according to owing analyses:

Bismuth	59·84	58.30
Tellurium	35·24	36·05
Sulphur	4·92	4·32
Earthy matter	0·00	0·75
	100·00 Wehrle.	99·42 Berzelius.

omposition appears to be one atom sulphuret of bismuth, o atoms bitelluret of bismuth. Formula: $BsSl+2BsTel^2$.

Sp. Gr. 7·2 — 8·0. Soft.

a light steel-grey inclining to lead-grey, with a metallic occurs in crystalline masses, or six-sided prisms, which isible into thin laminæ parallel to the terminal planes, so easily as mica; elastic, and when reduced to powder, n iron-black. B B, on charcoal, it melts on the first im- n of the point of the flame, into small globules, which e of a yellow color, and somewhat tarnished, disengaging same time vapors of selenium. When pulverized, it is in nitric acid, with the exception of the sulphur.

ccurs with brown spar and iron-flint at Pilsen, and near owitz on the Gran in Hungary; but it is an extremely ineral.

Kobell has detected this rare mineral in specimens of flame, being either dissipated or fused into a metallic globule, according to circumstances. Soluble in nitric or muriatic acids.

NATIVE ARSENIC.

Gediegon Arsenic, W. Arsenic Natif, H. Native Arsenic, J. Rhombohedral Arsenic, M. Arsenium rhombohedrum, D.

It consists of pure metallic arsenic, As, usually mixed with a small portion of other metals. Two specimens from Joachimsthal, yielded the following:

Arsenic	96·0	97.0
Antimony	3·0	2·0
Iron and water	1·0	1·0
	100·0 John.	100·0 John.

Sp. Gr. 5·75. H. = 3·5.

When fresh broken, it presents a lead-grey color, inclining to tin-white, but is generally greyish-black, becoming dull on exposure; it occurs reniform, botryoidal, and in flat mammillary masses; is not found crystallized, although indications of a rhomb of 114° 26′ and 65° 34′ have been noticed; cleavage occasionally observable perpendicular to the axis of this rhomb; fracture fine-grained and uneven, occasionally with a slight appearance of fibrous structure; it yields to the knife, and is easily frangible. B B, it fuses readily: burns with a bluish flame and a dense white arsenical vapor; and is, when pure, entirely volatilized. Acquires resinous electricity from friction.

Arsenic occurs chiefly in the veins of primitive rocks, accompanying ores of silver, cobalt, and copper. It is common in the Saxon silver mines of Freyberg, Annaberg, and Schneeberg; also at Joachimsthal in Bohemia, at Andreasberg in the Hartz, at Kapnick in Transylvania, at Orawitza in the Bannat, at Zmeoff in Siberia in large masses, at Wittichen in Suabia, and at St. Marie aux Mines in Alsace. It is at once distinguished by the facility with which it volatilizes, as well as by the odor and copious white fumes it emits when exposed to the blowpipe, or thrown upon ignited charcoal. This odor is also distinctly perceptible when the specimen is struck with a hammer. The effects of arsenic as a violent poison are well known; it is notwithstanding made use of in several pharmaceutical preparations, and is variously employed in metallurgical processes. — *Allan's Manual.*

Native arsenic, according to Dr. Jackson, occurs in argillaceous slate at Haverhill, N. H.

ARSENOUS ACID.

Arsenic, J. Octahedral Arsenic Acid, M. Arsenikblüthe, *Karsten*. Arsenic Oxidé, H. Acide Arsenieux, *Beudant*. Acidum Arsenosum, D.

posed, according to Berzelius, of arsenic 75·82, oxygen
Formula: $\dot{A}s$.

Sp. Gr. 3·6—3·71. H. = 1·5.

r snow-white, sometimes tinged accidentally reddish, sh, or greenish. It occurs earthy, capillary, investing ubstances, in stalactites, and also in tabular and pris- crystals. Cleavage octahedral; semi-transparent or lustre vitreous; fracture conchoidal; taste astringent. in hot water. Exposed to a high temperature it is zed without any odor, but when heated on charcoal, B B, d is decomposed, and the strong garlic smell which cha- zes metallic arsenic is emitted.

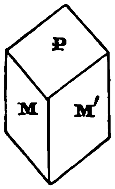
curs at Andreasberg in the Hartz, with the ores of arsenic, and lead, from the decomposition of some of it probably arises; also at Joachimsthal in Bohemia; Bieber in Hanau. It resembles the pharmacolite, and confounded with it: but that substance is not soluble r, which the oxide of arsenic is.

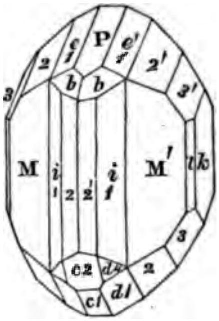
me of the Hartz furnaces it has been obtained by sub- n, and in that case it presents large distinct octahedral s.

SULPHURET OF ARSENIC.

site. Fracture conchoidal, with a splendent vitreous lustre; streak orange-yellow or aurora-red; yields to the pressure of the nail. It becomes electric by friction, acquiring the resinous or negative electricity; B B, alone, on charcoal, it burns with a pale yellow flame. Loses its color in nitric acid.

Primary.





M on M′	74°	15′	M′ on e′2	185°	2′
P on M or M′	104	6	—— e′3	141	20
—— *b* or *b*	149	12	—— *i*1	172	6
—— *c*2	80	0	—— *i*2	160	42
—— *e*1 or *e*1′	156	30	—— *k*	142	42
—— *e*2 or *e*2′	138	22	—— *l*	163	35
—— *e*3 or *e*3′	126	50	*c*1 on *c*2	150	38
—— *k*	90	0	—— *d*1	155	10
M on *b* or M′ on *b*′	133	2	—— *d*2	137	20
M or M′ on *c*1	99	30	—— *d*3	125	41
—— —— *c*2	115	52	—— *k*	90	00
M′ on *d*1	119	30	*c*2 on *d*4	161	20
—— *d*2	131	34	*i*2 on *i*2′	112	55
—— *e*′1	122	50			

Felsobanya in Upper Hungary, and Kapnik and Nagyag in Transylvania, are the most noted localities of this beautiful mineral; it also occurs at Andreasberg in the Hartz; in dolomite on St. Gothard; in Bohemia; in Saxony; and in minute crystals in the vicinity of active volcanoes, as Vesuvius, the Solfatara, &c.

SESQUISULPHURET OF ARSENIC.

ORPIMENT.

Prismatoidal Sulphur, M. Prismatoidal Sulphur or Yellow Orpiment, J. Gelbes Rauschgelb, W. Arsenic Sulfuré Jaune, H. Euchroa aurea, D.

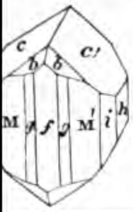
Orpiment consists of sulphur and arsenic in the following proportions:

Arsenic	62·0	61·86
Sulphur	38·0	38·14
	100·0 Klaproth.	100·00 Laugier.

se numbers answer to one and a half atom sulphur, one
rsenic. Symbols: $AsSl^{1\frac{1}{2}}$. Or we may double these
rs, and regard it as a compound of three atoms sulphur
o atoms arsenic.

Sp. Gr. 3·45.

r bright lemon-yellow, passing into gold yellow.* Oc-
isseminated, reniform, in stalactites, investing, and also,
rarely, in minute crystals. The primary form appears
Right rhombic prism of 100° and 80°, but the crystals
o cleavage parallel only to the greater diagonal of the
namely, parallel to the plane *f* of the following figure.
ransparent, or translucent only on the edges; lustre me-
pearly upon the perfect faces of cleavage, the rest resi-
streak yellow, somewhat paler than the color; sectile,
minæ flexible, but not elastic. B B, its comportment
onds with that of realgar; it burns, however, with a
colored flame.

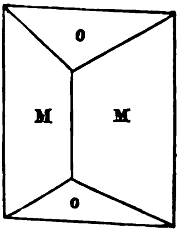


M on M	100°	0′
M on *c* or M on *c*′1	120 ?	0
M or M′ on *f*.	140	0
—— ——— *g*	177	54
M′ on *i*	162	38
c on *c*′.	83	30
—— *b*.	145	50

A considerable variation is observed in the results of these three analyses. The constitution of the mineral as deduced from the last, is very nearly two atoms arsenic, one atom iron. Symbols : FAs^2.

Sp. Gr. 7·1 — 7·4. H. = 5·0 — 5·5.

Primary form a Right rhombic prism of 122° 26′ and 57° 34′. Seldom occurs crystallized, generally in masses of a silver-white or steel-grey color ; lustre metallic ; streak greyish-black ; cleavage distinct perpendicular to the axis ; fracture uneven ; brittle. The measurements are, M on M 122° 26′, *o* on *o* over the apex 51° 20′.



This mineral is found associated with copper nickel at Schladming in Styria ; with serpentine at Reichenstein in Silesia ; and in a bed of sparry iron, along with bismuth and scorodite, at Löling near Huttenberg in Carinthia ; also at Fossum in Norway. It occurs, however, only in small quantities, and is a rare species.

Jordan* has described a variety of this species from near Andreasberg, which is in white brilliant needleform crystals.

Dana mentions, that a crystal, weighing two or three ounces, has been found in Bedford county, Penn. ; also, a mass in Randolph county, N. C., weighing nearly two pounds.

BRIGHT WHITE COBALT.

Cobaltine, *Beudant.* Glanz Kobalt, W. Cobalt Gris, H. Cobalt Eclatant, Br. White Cobalt, A. Octahedral Cobalt Pyrites, J. Hexahedral Cobalt Pyrites, M. Sulpho-Arsenide of Cobalt, *Thomson.* Argyrites hemi-cubicus, D.

Combination in nearly equal volumes of the sulphuret and the arseniuret of cobalt.

	Skutterud.	Tunaberg.	Tunaberg.
Cobalt	33·10	36·66	44·00
Arsenic	43·47	49 00	55·00
Sulphur	20·08	6·66	0·50
Iron	3·23	5·66	0·00
	99·88 Stromeyer.	97·98 Tessaret.	99·50 Klaproth.

The first analysis gives one atom cobalt, one atom arsenic, and one atom sulphur. By doubling these numbers, and supposing the sulphur to be in combination with both arsenic and cobalt, we obtain one atom disulphuret of cobalt, one atom disulphuret of arsenic ; the latter being, according to Dr. Thomson, a sulphur acid. Formula : As^2Sl+Cb^2Sl. Berzelius s it to be a bisulphuret and biarseniate of cobalt, $CbSl^2$ s^2, and this may be thought to be the most correct view omposition.

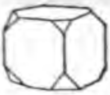
---

* Berzelius' Rapport Annuel, 1843, p. 211.

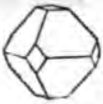
Sp. Gr. 6·23. H. = 5·5.

r silver- or yellowish-white, with a tinge of red. It oc- the cube and its varieties — its crystalline forms resem- hose of iron pyrites; the planes of the cube are gene- triated, those of the modifications smooth; structure r, yielding readily to cleavage parallel with all the of the Cube, which therefore is the primary form; frac- ie grained; streak greyish-black; it also occurs arbo- , stalactitic, botryoidal, and amorphous; it yields with ty to the knife, and is not very frangible. B B, on char- disengages copious arsenical fumes, and, after being l for some time, melts into a metallic globule of a dull externally, which attracts the magnet, but which is not ble; it tinges borax of a deep-blue color; and effervesces ed nitric acid.

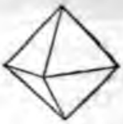
2.



3.

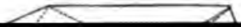


4.



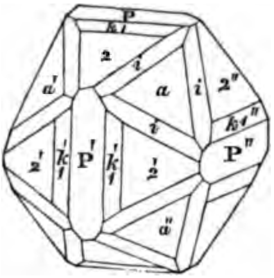
).

5 (b).



7.

Fig. 5 (*b*) represents a crystal of bright white cobalt of the natural size from Tunaberg in Sweden. Some of its faces are disproportionately extended, but it possesses great symmetry and beauty of finish, for a crystal of such dimensions; and it is not easy to discover the surface by which it was connected with the matrix. It is valued at £50.



P on P' or P''	90° 00'	H.
a on *a'* or *a''*	109 28	—
PP' or P'' on *a*	125 15	—
P on *k*1, P' on *k*1'	166 30	
P on *k*2, P' on *k*2'	153 26	H.
a or *a'* on *k*2	140 46	—
a on *i*	163 27	
*k*2' on *k*2'	126 52	H.

At Tunaberg and Hokensbo in Sweden, this species is met with in large resplendent, distinctly-pronounced crystals, which are generally combinations of the cube and pentagonal dodecahedron, as in fig. 5. It also occurs abundantly in mica-slate at Wehna in Sweden, and at Modum and Skutterud in Norway; less so at Querbach in Silesia, and in the vicinity of St. Just in Cornwall. From the following species it may be distinguished by its inferior specific gravity and reddish hue, also by its lamellar structure, its more distinct cleavage, and by its requiring considerably greater heat to drive off the arsenic.

TIN-WHITE COBALT.

Octahedral Cobalt Pyrites, M. Octahedral Cobalt Pyrites, J. Grauer Spieskobold, W. Cobalt Arsenical, *Necker.* Tin-White Cobalt, L. Grey Cobalt, A. Binarseniet of Cobalt, *Thomson.* Smaltine. Argyrites octahedrus, D.

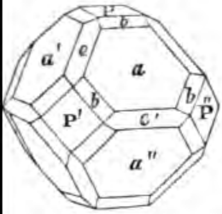
Union of cobalt and arsenic, in which the latter preponderates; sometimes containing small quantities of copper and iron.

	Riechelsdorf.	Schneeberg.
Cobalt	20·31	28·00
Arsenic	74·21	65·76
Iron	3·12	0·00
Copper	0·15	6·25
Sulphur	0·88	0·00
	98·97 Stromeyer.	100·00 John.

Dr. Thomson (adopting the first analysis) observes that if we admit that the copper, and a portion of the arsenic, are in the state of sulphurets, then this mineral will consist of binarseniates; viz. six and a half atoms binarseniate of cobalt, one atom biarseniate of iron. Formula: $6\frac{1}{2}CbAs^2+FAs^2$.

Sp. Gr. 6·4 — 7·7. H. = 5·5.

Color tin-white, inclining, when massive, to steel-grey. It s in cubes, Octahedrons, and in crystals which form the ge of the one into the other (see Bright White Cobalt, fig. 3, 4); but it is somewhat remarkable that the crystals of ariety differ from the preceding, in exhibiting only the ar planes of modification belonging to the cube. The ls are often cracked or rent in various directions, and planes are commonly more or less convex. Cleavage lel to the faces both of the octahedron and cube. It also s arborescent, reticulated, botryoidal, stalactitic, and phous. The fracture is fine-grained and uneven, with a ning metallic lustre; it yields with difficulty to the knife, s brittle and hard. B B, on charcoal it gives out a copi- rsenical vapor on the first impression of the heat; it however, only partially, and that with difficulty; to borax ther fluxes it imparts a deep blue color; and in nitric affords a pink solution.



P on P' on P''	90°	00′
P P' or P'' on a	125	16
P on b, P' on b, or P'' on b .	155	10
P or P' on e	135	5
a on a' or a''	109	28
a on b, b, or b	151	30
a or a' on e	144	55
e on e'	120	00

occurs chiefly in primitive rocks, accompanying ores of atoms of which are nearly equal, it is evident that the other constituents are in the state of terarseniets, and the mineral consists, as stated by Dr. Thomson, of nine atoms terarseniet of Cb., four atoms terarseniet of F., one atom terarseniet of Cp., one atom terarseniet of Nk. If the two last be regarded as accidental, the composition is thus expressed: $9CbAs^3+4FAs^3$.

Occurs massive, with a radiated and porous-like structure. Color intermediate between lead-grey and steel-grey, with a glistening or glimmering metallic lustre; streak dull, same color as the mineral. B B, it emits copious fumes of arsenious acid, and deposits on the charcoal a yellow crust, the assay at the same time assuming a brown color. When well roasted, it communicates to borax a smalt blue color.

This mineral has hitherto only been found at Schneeberg in Saxony.

SULPHURET OF COBALT.

Kobalt-Kies, J. Koboldine, *Beudant.* Schwefel Kobalt, *Berzelius.* Isometric Cobalt Pyrites, M. Cobalt Sulfuré, *Lucas.* Cobalt-Kies, L. Cobalt Pyriteux, *Necker.* Argyrites cubicus, D.

Sulphuret of cobalt, mixed with the sulphurets of iron and copper.

	Ridderhyttan.	Mussen.	Musson.
Cobalt	43·20	43·86	53·35
Copper	14·40	4·10	0·97
Iron	3·53	5·34	2·30
Sulphur	38·50	41·00	42·52
	99·63 Hisinger.	94·30 Wernekink.	98·87 Wernekink.

The first analysis, throwing out the copper and iron as accidental impurities, gives one and a half atom sulphur to one atom cobalt. It is therefore a sesquisulphuret of cobalt. Formula: $CbSl^{1\frac{1}{2}}$. Rammelsberg gives the same atomic constitution from the last analysis by Wernekink.

Sp. Gr. 6·3—6·4. H. = 5·5.

Color steel-grey, or whitish with a tinge of yellow; massive, with an uneven fracture, presenting a granular surface; and botryoidal. Lustre metallic; cleavage parallel to the faces of the cube, imperfect; fracture uneven or imperfect conchoidal. On charcoal alone B B, it fuses after roasting into a grey metallic globule, from which it is difficult to drive off the last portions of sulphur; with the fluxes the effects of the cobalt predominate so much that it is impossible to distinguish those of iron or copper. Soluble in nitric acid, with the disengagement of nitrou gas, leaving a whitish residue. Neither in the analysis, nor B B, does it exhibit the slightest indication of arsenic.

s found at Bastnaes near Riddarhyttan in Sweden, in
, associated with copper pyrites and hornblende; and at
n in Prussia, with barytes and carbonate of iron.

EARTHY COBALT.

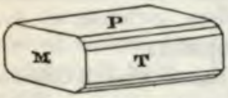
balt Ochre, A. Oxide of Cobalt. Erdkobold, W. Cobalt Oxydé Noir, H.
Cobalt Ochre, J. Manganus cobaltiferus, D.

as been analyzed by Klaproth and Döbereiner, but with
ifferent results. According to the latter, it consists es-
ly of oxide of cobalt and protoxide of manganese, united
bout 23 per cent. of water.

Sp. Gr. 2·10 — 2·42. Soft.

r various shades of brown, bluish-black, and black.
massive, mamillary, botryoidal, investing, and pulveru-
he fracture of the massive is earthy, and it is dull, but
s a polish by friction; yields easily to the knife. B B,
rcoal it exhales a slight arsenical odor, but does not fuse;
rax it forms a deep cobalt-blue colored globule.
curs in sandstone, with yellow copper, at Alderley Edge,
shire; at Nertschinsk in Siberia; and at Riechelsdorf
sia; at Saalfeld in Thuringia, associated with several
of cobalt pyrites; in the Tyrol, Bohemia, Saxony, and
ere. In Ireland, of a blue color, investing fissures in
ay in the peninsula of Howth near Dublin. The bril-
which its surface attains when streaked with, or rubbed

crystals, which possess most nearly the characters of regular form, are translucent and shining, the other varieties are glimmering or dull, and nearly opake; it is soft, light, and flexible; translucent; the red tints very brilliant by strong transmitted light; lustre pearly, on some faces inclining to vitreous; streak corresponding to the color, though a little paler. When crushed in a dry state, the powder possesses a lavender-blue tinge, which is not the case if moistened. Cleavage perfect, in the direction of the prism. B B, on charcoal, it fumes abundantly, emitting an arsenical odor, and melts in the reducing flame into a bead of arseniuret of cobalt. With borax and other fluxes it yields a fine blue-colored glass; and is soluble in nitric acid, to which it communicates a red tinge.



M on T . . . . 124° 0′ — Brooke.

It occurs in primitive and secondary rocks, with other ores of cobalt; either in micaceous scales radiating from a centre, as at Schneeberg in Saxony; in minute aggregated crystals, as at Saalfeld in Thuringia, and Riegelsdorf in Hessia; or coating other minerals in the state of a peach-blossom red-powder. This last is met with in Dauphiné, in Cornwall, at the lead mine of Tyne Bottom near Alston in Cumberland, and in many other places. A perfectly green variety occurs at Platten in Bohemia; and sometimes red and green tinges appear on the same crystal.

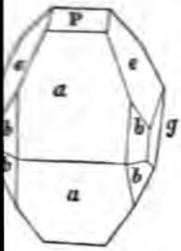
ROSELITE.

Levy. (*Annals of Philosophy*, viii. 439.) Gypsalus Cobalticus, D.

Contains oxide of cobalt, arsenic acid, water, lime, and magnesia, according to Children.

H. = 3·0.

Lustre vitreous; translucent; streak white; cleavage distinct, and brilliant parallel to P. The primary form is a Right rhombic prism, M on M′ 125° 7′. — *Brooke.* B B, it gives off water and blackens. It imparts a blue color to borax and salt of phosphorus; and is entirely soluble in muriatic acid. This species resembles the last in color, though quite distinct in crystalline form.



a on *a* over P . . . . 47° 12′ — Levy.

s extremely rare mineral occurs in small deep rose-red d twin crystals, associated with cobalt bloom, at Schnee- Saxony. It was noticed by Levy, who named it in com- t to Dr. Gustavus Rose of Berlin. — *Allan's Manual.*

SULPHATE OF COBALT.

iol, J. Kodalt Vitriol, *Koppe*. Rhodhalose, *Beudant*. Vitriolum Cobalticum, D.

constituents of this mineral have been variously deter- as follows:

	Bieber.	Bieber.	Bieber.
huric acid	30·2	19·74	29·053
le of cobalt	28·7	38·71	19·909
le of iron	0·9	0·00	0·000
er	41·2	41·55	46·830
nina	0.0	0·00	3·864
	101·0 Beudant.	100 00 Koppe.	99·656 Winkelblech.

SULPHURET OF NICKEL.

Native Nickel, M. J. Schwefel-Nickel, L. Haarkies, W. Capillary Pyrites, H. Nickel Sulfuré, *Levy*. Pyrites capillaris, D.

Analyses by Arfvedson.

Nickel	64·76	65·35
Sulphur	35·24	34·26
	100·00	99·61

These numbers approach very nearly to one atom of each constituent — NkSl, or $\overset{\prime}{N}i$, as stated by Rammelsberg.

Sp. Gr. 6·45. H. about 4.

It occurs in capillary and sometimes diverging filaments of a yellowish color, inclining to steel-grey. Primary form the Cube; flexible; opake, with a metallic lustre; not magnetic. B B, on charcoal, with a good heat, it fuses into a globule which is metallic, malleable, and magnetic, and consists wholly of nickel; but in the open tube it exhales the odor of sulphurous acid. With nitric acid, it forms a greenish solution.

It is found at Joahnngeorgenstadt in Saxony, at Joachimsthal in Bohemia, at Andreasberg in the Hartz, Myrthyr Tydvil in Wales, in Cornwall and other places, in thin capillary filaments, filling the cavities, and dispersed among the crystals of other minerals.

ANTIMONIAL NICKEL.

Antimoniet of Nickel, *Thomson*. Argyrites hexagonus, D.

This mineral has been twice analyzed by Stromeyer, who obtained the following results:

Nickel	28·946	27·054
Antimony	63.734	59·706
Iron	0·886	0·842
Sulphuret of lead	6·437	12·357
	99·983	99·959

The constituents approach pretty nearly to one atom nickel and one atom antimony, there being a slight excess in the quantity of nickel. Formula: NkSt.

Its specific gravity has not been determined; its hardness is about that of copper nickel. Color in the fresh fracture light copper-red, inclining strongly to violet; powder reddish-brown. Occurs crystallized in short six-sided prisms, which appear to be regular; sometimes they are terminated in six-sided pyramids. Fracture uneven, passing into small conchoidal. Lustre metallic, splendent. Brittle. Not acted upon by the magnet. B B, some antimony sublimes. This mineral was ered by M. Volkmar in the Andreasberg mountains, ated with sulphuret of lead and speiss copper. It resem-pper nickel.

SULPHO-ANTIMONIAL NICKEL.

rous Grey Antimony, J. and A. Eutomous Cobalt Pyrites, M. Nickelspies-, *Haussmann.* Nickel Arsenical Antimonifère, Antimoine Sulfuré Nickelifère, n-nickel, *Beudant.* Argyrites eutomus, D.

bination of nickel, sulphur, and antimony, sometimes rsenic.

	Siegen.	Siegen.	Altenkirchen.	Siegen.	Freussberg.
	28·04	27·36	23·33	26·10	25·25
	15·55	15·98	14·16	16·40	15·25
	54·47	55·76	61·68	47·56	47·75
	0·00	0·00	0·00	9·94	11·75
	98·06 H. Rose.	99·10 H. Rose.	99·17 John.	100·00 Ullman.	100·00 Klaproth.

constitution of this mineral from the three first analy-two atoms nickel, one atom sulphur, and one atom anti- The nickel is thus supposed to be in the state of a ret and antimoniet. Formula: $\mathrm{NkSl}+\mathrm{NkSt}$. Beudant es the arsenic with the antimony, and thereby obtains ne formula from the other two analyses.

Sp. Gr. 6·45 — 6·5. H. = 5·0 — 5·5.

nary form the Cube. In masses which have a granular sition, and possess a steel-grey or silver-white color; metallic; cleavage perfect parallel to the faces of the brittle. B B, it is partly volatilized, disengaging va-

Stromeyer's specimen, which seems to have been the purest, shows nearly an equality in the atoms of the constituents, whence the mineral is a simple arseniet of nickel — NkAs.

Sp. Gr. 6·6 — 7·6 H. = 5·0 — 5·5.

Of a copper or yellowish-red color, but acquiring a grey or blackish tarnish by exposure. It occurs reticulated, dendritic, and botryoidal, but more commonly massive; never crystallized; streak pale brownish-black. The fracture is imperfectly conchoidal, or fine-grained and uneven, with a glistening or shining metallic lustre; it yields to the knife with difficulty, and is brittle. B B, it gives out an arsenical vapor, and then fuses, though not very easily, into a white metallic globule. After roasting, it usually colors glass of a borax blue, indicating the presence of a certain quantity of cobalt. In nitric acid it assumes a green coating, and in nitro-muriatic acid is dissolved.

It usually accompanies the ores of cobalt, silver, and copper; and is found in the veins of primitive rocks at Schneeberg and Annaberg, Johanngeorgenstadt and Freyberg in Saxony; at Schladming in Styria; Joachimsthal in Bohemia; at Allemont in France, and the Bannat; in transition rocks in the Hartz; at Saalfeld in Thuringia; at Riegelsdorf in Hessia; and, though less frequently, in Cornwall.

BINARSENIET OF NICKEL.

White Nickel. Argyrites Hoffmanni, D.

This mineral has been described and analyzed by Hoffman. — *Pogg. Ann.*, xxv. 302. He obtained the following constituents:

Arsenic	71·30
Nickel	28·14
Sulphur	0·14
Bismuth	2·19
Copper	0·50
	102·27

The atoms of arsenic are so nearly double those of the nickel, that, supposing the other constituents to be accidental, it is obvious that the mineral is composed of two atoms arsenic, and one atom of nickel. Formula: $NkAs^2$.

Its color is tin-white; lustre metallic; opake; massive, and not described as crystallized; surface often mixed with small concretions of quartz; fracture uneven. It is often covered with a thin coating of diarseniate of nickel. It occurs at Schneeberg.

A variety of this species, differing from it in containing a

ortion of cobalt, is found crystallized in regular hexa-
s at Riegelsdorf in Hesse. It contains by the analysis
th, arsenic 72·64, nickel 20·74, iron 3·25, cobalt 3·37.

NICKEL GLANCE.

o-Arsenide of Nickel, *Thomson*. Nickelglanz. Argyrites decrepitans, D.

elius has subjected this mineral to four different analy-
d his results are as below stated. It has also been
ed by Pfaff and Rammelsberg.

	Loos in Sweden.		Loos in Sweden.		Mean.	Atoms.
	55·50	53·32	48·06	45·37	50·56	10·64
	12·67	14·40	19·29	19·34	16·42	8·21
	28·17	27·00	30·80	29·94	28·98	8·91
	3·63	5·29	2·99	4·11	4·00	1·14
ith cobalt	0·00	0·00	0·00	0·92		
	0·61	0·00	1·00	0·90		
	100·58	100·01	102·14	100·58		

mean numbers of these analyses lead to one atom each
three first constituents, if we suppose, with Dr. Thom-
at the excess of arsenic is in combination in the mine-
h the iron, and is accidental. By doubling these atoms,
pposing the sulphur to be united with each of the bases,
ains one atom disulphide of arsenic, and one atom disul-
of nickel. Formula: As^2Sl+Nk^2Sl.

	Haueisen.	Atoms.
Nickel	31·819	9.79
Arsenic	48·022	10·11
Sulphur	20.159	10·07

NICKEL OCHRE.

Nickel Blüthe, Nickel Ocher, W. Nickel Oxidé, H. Bt. Nickel Arseniaté, *Berthier*. Niccalus prasinus, D.

Combination of arsenic acid, oxide of nickel, and water.

Arsenic acid	36·97	36·8
Protoxide of nickel	37·35	36·2
Water	24·32	24·5
Protoxide of cobalt	0·00	2·5
	98·64 Stromeyer.	100·0 Berthier.

Dr. Thomson unites the oxides of nickel and cobalt, which together make two atoms against one atom arsenic acid. The water amounts to four atoms. The mineral is therefore a hydrous diarseniate of nickel. Formula: $Nk^2\dot{As}+4Aq$.

This substance is found adhering to or coating arsenical nickel, and is considered to be derived from its decomposition. It is sometimes compact, of a fine apple-green color; and generally filamentous or friable. By calcination it assumes a yellowish hue, and loses somewhat less than a fourth part of its weight of water, without emitting any odor. It dissolves readily and completely in acids, without effervescence, the solution becoming violet on the addition of ammonia; and B B, on charcoal exhales a strong arsenical smell; fusing in the interior flame into a globule of arseniferous nickel. It is found adhering to arsenical nickel at Allemont, and other places.

PIMELITE.

Pimelit, W. Br. Nickel Oxydé, Bt. Pimelite, J.

Oxide of nickel 15·62, silica 35·00, alumina 5·10, water 37·91, magnesia 2·25, lime 0·40. — *Klaproth.* Rammelsberg has given no formula for this mineral.

Of an apple-green or yellowish-green color; occurs investing other minerals, and massive; is earthy and dull; opake, and devoid of lustre; soft, and greasy to the feel. It is infusible B B, but loses part of its weight, and assumes a dark-grey hue. With borax it forms a violet-colored globule, in which the nickel is reduced.

It occurs at Kosemütz, and Glassendorf in Silesia, in veins traversing serpentine, and associated with chrysoprase, of which nickel is supposed to be the coloring matter.

NATIVE SILVER.

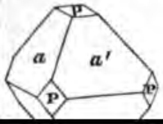
Gediegen Silber, W. Argent Natif, H. Br. Hexahedral Silver, M. and J. Argentum octahedrum, D.

Pure silver, with occasional minute admixture of copper, arsenic, antimony, and iron, which renders it less malleable

he fused metal. That from Curey, analyzed by Berthier,
omposed of silver 90, copper 10, or two and a half atoms
to one atom copper. Formula: $Ag^{2\frac{1}{2}}Cp$.

Sp. Gr. 10·47. H. = 2·5.

or pure white, with a shining metallic lustre, but gene-
arnished externally of a greyish-black, probably owing to
esence of sulphur. Occurs crystallized in the Cube and
ar octahedron; but as it does not possess a lamellar
ure, either of these solids may be considered as the pri-
form; in the following figure the cube is assumed, as
the most simple. It also occurs capillary, ramose, and
lated, but a close inspection will discover, by the assist-
of a microscope, that these varieties consist of a congeries
ngated crystals, or of minute cubes or octahedrons closely
gated, and disposed perpendicularly in straight rows.
le, ductile, and malleable; acquires vitreous electricity
isolated and rubbed. It is fusible, B B, into a globule,
is not altered by continuing the heat, although, on cool-
t presents a crystalline form, in which the faces of the
dron, cube, and dodecahedron may be distinguished.
oluble in cold nitric, and in heated sulphuric acid.



P on P or P	90°	00′ H.
P on *a* or *a′*	125	15
a′ on *a* or *a*	109	28

forty pounds. Specimens brought from the celebrated Pasco mine, in Peru, as described by Prof. Silliman, are of the most perfect whiteness without tarnish, and with the lustre of the highly polished metal; their numerous crystals adhering in rich groups of many hundreds, and being also interspersed through brilliant white calc-spar, make a very splendid appearance. The figures are between the cube and the octahedron — usually the cubo-octahedron. Specimens of native silver have been sent to the United States, by the American missionaries from Western Asia, concerning the mineralogy of which but little is known. At Madden, south-east of Trebizond, a valuable mine of native silver is wrought by the Greeks.*

In the United States, native silver was found by Dr. Houghton, in the trap rocks of Michigan, associated with native copper. It is found also at King's lead mine, Davidson county, North Carolina.

The employment of silver in coinage, and in the manufacture of plate and articles of luxury, is well known; but it is not from this ore alone that the fused metal is obtained.

Auriferous Native Silver. Guldisches gediegen silber, W. Argent natif aurifère, Br.

Gold	64·0	74·0	76·41	28·0
Silver	34·0	26·0	22·12	72·0
	98·0 Klaproth.	100·0 Boussingault.	98·53 Rose.	100·0 Fordyce.

The gold is thus united in very variable proportions, and in some specimens should rather be regarded as native gold. Specific gravity 14·0 -- 17·0.

Of a color between silver-white and brass-yellow; disseminated, capillary, and crystallized in cubes.

It occurs in veins at Kongsberg in Norway, at Rauris in Salzburg, and at Schlangenberg in Siberia.

ANTIMONIAL SILVER.

Prismatic Antimony, M. Octahedral Antimony, J. Antimon-silber, *Leonhard*. Spiesglassilber, W. Argent Antimonial, H. Br. Stibium rhombicum, D.

A specimen from Wolfach, yielded to Klaproth, silver 76, antimony 24. Another by Vauquelin, from Andreasberg, gave silver 78·0, antimony 22·0. The mineral appears, from these analyses, to be a diantimoniet of silver. Formula: Ag^2St.

Sp. Gr. 9·44 — 9·8. H. = 3 5.

Color between silver-white and tin-white, often externally tarnished yellow or reddish. Generally occurs massive or in grains, but has been observed also indistinctly crystallized.

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* Prof. Hitchcock on the Geology of Western India, vol. i. p. 396, of the Reports of the Association of American Geologists.

ry form an obtuse rhomboid of 109° 28′ and 70° 32′. —
. The faces somewhat convex, and deeply striated
dinally. Structure lamellar, with a shining metallic
and the cross fracture flat conchoidal; easily frangible;
nd possessing a slight degree of malleability. B B, on
al it melts into a grey metallic globule, which is not
ble, the antimony being at the same time driven off in
vapor; on continuing the blast a bead of pure silver is
ed. In nitric acid it becomes soon covered with a
coating, which is the oxide of antimony.
ccurs with native arsenic and other ores of silver, in
, at Wittichen and Altwolfach in Baden; in clay-slate
reasberg in the Hartz; also at Casalla near Guadal-
n Spain; in Salzburg; and at Allemont in France. It
re mineral.

NICAL ANTIMONIAL SILVER. Arsenical Silver, A. Argent
ial ferro-arsenifère, H. Argent arsenical, Br. Antimonial silver,
vith arsenic and iron. A specimen from Andreasberg yielded to
h, silver 12·75, antimony 4·00, iron 44·25, arsenic 35·00. Another
n gave very different results, tending to show that the mineral is a
ical mixture of its constituents. Specific gravity 9·4; hardness 4·0.
ly of the same color as native silver, but commonly tarnished yel-
lackish; it occurs mammillated, or in small globular and reniform
sometimes investing other substances; structure lamellar, with a
or glimmering metallic lustre. It is harder than antimonial sil-
t is sectile, brittle, easily frangible, and heavy. B B, the arsenic
imony are volatilized, emitting at same time a powerful alliaceous
d leaving a globule of impure silver.

yellow; and is soluble in nitric acid, especially if heated. From the silver mines of Savodinski in the Altai mountains, Siberia.

SULPHURET OF SILVER.

Vitreous Silver. Glaserz, W. Argent Sulfuré, H. Bt. Argent Vitreuse, Br. Hexahedral Silver Glance, M. Silver Glance, J. Lunites dodecahedrus, D.

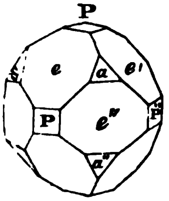
Combination of silver and sulphur.

	Freyberg.	Atoms.
Silver	85·0	6·18
Sulphur	15·0	7·5
	100·0 Klaproth.	

The only published analysis of this mineral appears to be that by Klaproth. — *Beitrage*, i. 158. Rammelsberg gives no other. The numbers do not exactly correspond with one atom silver and one of sulphur; though such is undoubtedly the true constitution of the mineral. Formula: $\overset{\prime}{\mathrm{Ag}}$ or AgSl.

Sp. Gr. 6·9 — 7·2. H. = 2·0 — 2·5.

Of a dark lead-grey color, with occasionally a superficial iridescent tarnish. Primary form the Cube; also found in octahedrons and rhombic dodecahedrons, parallel to the faces of which, traces of cleavage are sometimes observable; fracture, fine grained and uneven, sometimes small and flat conchoidal, with a more or less shining metallic lustre; malleable and sectile, yielding readily to the knife. In the flame of a taper, or B B, it intumesces, the sulphur flies off, and on continuing the blast a bead of pure silver remains. Soluble in dilute nitric acid; and, when isolated and rubbed, acquires a resinous electricity.



P on P' or P''	90°	00' H.
PP' or P'' on *a*	125	15
P or P' on *e*	135	00
a on *a'* or *a''*	109	28
a or *a'* on *e*, or *a* or *a''* on *e''*	144	44
e on *e'* or *e''*	120	00

This species occurs both crystallized and massive, assuming also various reticulated, filiform, arborescent, and capillary shapes. It is subject to tarnish from exposure, loses its lustre, and becomes covered with a black earthy-like coating. It occurs in gneiss at Freyberg in Saxony, accompanying other ores of silver; in mica-slate at Joachimsthal in Bohemia; in greywacke in the Hartz; occasionally in Devon and

all in grauwacke with native silver and arsenical silver;
great abundance only in Mexico, most of the silver ob-
at the celebrated mines of Guanaxuato in that country
extracted from this ore. It occurs also in Peru.

ck Sulphuret of Silver. Silberschwartze, W. Earthy sil-
nce, J. Is a decomposed and almost friable variety of the preced-
t is dark lead-grey, inclining to black, and without lustre, or only
glimmering; it occurs massive and pulverulent, sometimes invest-
er ores of silver, and filling up cavities in them; fracture uneven,
or less sectile; and gives a shining metallic streak. B B, it is
ted into a slaggy mass, containing globules of impure silver. It
in the veins of primitive mountains with other ores, as at Cremnitz
hemnitz in Hungary; at Chalanches near Allemont in Dauphiné;
gsberg in Norway; and at Schlangenberg in Siberia.

FLEXIBLE SULPHURET OF SILVER.

ulfuré Flexible, *Bournon.* Biegsamer Silberglanz, L. Ferro-sulphuret of Silver, *Thomson.*

nsists, according to Wollaston, of silver, sulphur, and a
ron; but no complete analysis has been given.
ernally of a dark color, approaching to black; occurs
nassive and in small tabular crystals, which appear to
ght oblique-angled prisms, whose lateral planes are alter-
125° and 55°. Flexible when in thin laminæ, and
y separable into them. Cleavage parallel with the ter-
planes; very soft, yielding readily to the knife; lustre

STERNBERGITE.*

Haidinger. (*Edinb. Phil. Trans.*, xi. 1.) Elasmites rhombicus, D.

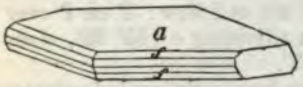
Contains, according to Zippe:

		Atoms.	
Silver	33·2	2·41	1·00
Iron	36·0	10·28	4·26
Sulphur	30·0	15·00	6·22
	99·2		

The composition, as indicated by these numbers, is four and a half atoms sulphuret of iron, one atom bisulphuret of silver. Formula: $4FSl+AgSl^2$.

Sp. Gr. 4·2 — 4·25. H. = 1·0 — 1·5.

Primary form a Rhombic octahedron of 118°, 84° 28′, and 128° 49′. The annexed figure exhibits one of the common secondary forms. It occurs also in compressed, but regular hexahedral tables, with two angles of 119½°, and four of 120¼°, and these are sometimes united in twins.



f on *f* . . . . 118° 00′. — Haidinger.

Occurs generally in implanted crystals, attached to the matrix laterally so as to form rose-like aggregations; sometimes they are macled. Cleavage perfect parallel to *a*. Color pinchbeck-brown, with an occasional superficial violet-blue tarnish on the faces *f*; high degrees of metallic lustre on the broad faces *a*, not so bright on the others; streak black; flexible in thin laminæ; and, after being bent, may be smoothed down again with the nail, like tinfoil. B B, it burns, *per se*, with a blue flame, emits powerful sulphurous vapors, and fuses into a globule, which is generally hollow, has a crystalline surface, and is covered with metallic silver. This globule acts powerfully on the magnet, and communicates to fluxes the ordinary colors produced by iron. Borax readily removes the iron, and leaves a button of metallic silver. In the matrass it loses its lustre, and becomes dark-grey, and friable. It leaves traces on paper like graphite, which may be removed by caoutchouc.

Sternbergite occurs with ores of silver, particularly the red and brittle silvers, at Joachimsthal in Bohemia; but it is a very rare species.

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* In honor of Count Caspar Sternberg of Prague.

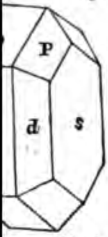
BRITTLE SULPHURET OF SILVER.

aserz, W. Argent Antimonié Sulfuré Noir, H. Prismatic Melane Glance, M.
Brittle Silver Glance, J. Schwarz Gültigerz, L. Lunites rhombicus, D.

	Freyberg.	Freyberg.
It contains Silver	66·5	68·54
Sulphur	12·0	16·42
Antimony	10·0	14·68
Iron	5·0	0·00
Copper	0·5	0·64
	94·0 Klaproth.	100·28 H. Rose.

s mineral according to Dr. Thomson, is a *trisulphoanti-te* of silver, thus expressed by the formula: $StSl^2+3AgSl$. ngular that an analysis of the same mineral by Brandes, ot a trace of antimony.*

Sp. Gr. 5·9 — 6·4. H. = 2·0 — 3·0.



Color dark lead or bluish-grey, passing into iron-black; when pulverized, dark-grey or brownish. Primary form a Right rhombic prism of 107° 47′ and 72° 13′. The measurements are as follow: P on P over *o* 104° 19′, *o* on adjoining *o* 115° 39′, *d* on *d* over P 107° 47′.

Crystals most frequently macled; cleavage in the directions of *o* and P; the structure imes distinctly lamellar, but the fracture commonly con-l, with a shining metallic lustre; soft, and brittle. B B, ts, the sulphur, antimony, and arsenic fly off, and there ns a dark-colored metallic globule, which may be reduced

SULPHURET OF SILVER AND ANTIMONY.

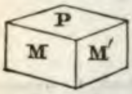
Peritomous Antimony Glance, M. Schwefel-Silber und Antimon, L. Argent Sulfuré Antimonifère et Cuprifère, *Levy*. Schwefel Schilfglazerz, *Freisleben*. Lunites peritomus, D.

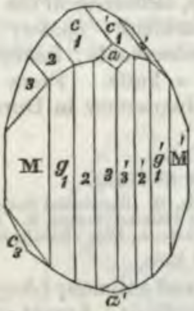
No complete analysis has hitherto been given of this mineral; but its elements are supposed to be sulphur, silver and antimony, united with accidental portions of copper.

Sp. Gr. 5·5—5·6. H. = 2·0—2·5.

It occurs in small crystals, sometimes irregularly associated, more often separate; externally they are shining and splendent, of a color approaching to silver-white; and deeply striated longitudinally; the striæ however are for the most part only a series of planes modifying the obtuse edges of the prism, as in the following figure. Cleavage perfect parallel to M; extremely brittle, yielding readily to mechanical division parallel to the planes of a Right rhombic prism of 100° and 80°, and probably also in other directions. B B, it emits copious white vapors, accompanied by a slight sulphurous odor, a small white bead, apparently of silver, remaining.

Primary.





M on M'	100°	00'
M or M' on *a* or *a'* . .	135	15
M on *c*1 or M' on *c*1' .	110	00
—— *g*1 or —— *g*1' .	70	10
—— *g*2 or —— *g*2 .	60	30
—— *g*3 or —— *g*3' .	146	30
a or *c*1 or *c*1'	120	12
*c*1 on *c*1'	130	8
—— *c*2	145	24
—— *c*3	143	25
*c*3 on *c*3	122	15

It occurs in the Himmelsfurst mine at Freyberg in Saxony, accompanying sulphuret of silver, blende, carbonate of iron, and galena; occasionally also at Kapnik in Transylvania.

Sulphuret of Silver, Lead and Antimony. — M. Wöhler has analyzed, and M. Hausmann has given a mineralogical description of a mineral of this composition, consisting of silver 22·93, lead 30·27, antimony 27·38, sulphur 18·74. — *Berzelius' Rapport Annuel for* 1840, p. 122. It crystallizes in six-sided prisms terminated by a six-sided plane, or by two planes; also in quadrangular oblique prisms, the inclination of the sides of which is 91° 89', and of which two of the opposite edges are replaced by faces which make with the faces of the inclined plane an angle of 146°. It is of a lead or steel-grey color; opake, and has a metallic lustre. The faces of cleavage are indistinct; its fracture imperfectly conchoidal. Specific gravity, 6·194; hardness, by Mohs' scale, between 2 and 2·5. B B, it gives the reaction of sulphur, of antimony, and of lead and silver.

We could probably regard this mineral as only a variety of the preceding, in which lead had replaced a part of the silver, were there not a wide

ce in the crystalline forms of the two, giving to each a specific cha-
According to the observation of Zinker, the Schilfglazerz from
schitz, in Bohemia, contains bismuth.

POLYBASITE.*

ll. *H. Rose.* (*Poggendorf's Annalen*, xv. 575.) Lunites rhombohedrus, D.

	Mexico.	Freyberg.
Silver	64·29	65·50
Sulphur	17·04	19·40
Antimony	5·09	0·00
Arsenic	3·74	3·30
Copper	9·93	3·75
Iron	0·06	5·46
	100·15 H. Rose.	97·41 Brandes.

mula given by Dr. Thomson from the first analysis :

$$\left.\begin{matrix}\mathrm{St}\\ \mathrm{As}\end{matrix}\right\}\mathrm{Sl}+5\left.\begin{matrix}\mathrm{Ag}\\ \mathrm{Cp}\end{matrix}\right\}\mathrm{Sl}$$

Sp. Gr. 6·214. H. = 2·0 — 3·0.

nary form a Rhomboid.† Occurs in tabular-shaped six-
prisms. The planes of the prism are striated parallel to
se, and the terminal faces parallel to the sides of an
ed equilateral triangle, indicative of the rhomboid being
nary form. Color iron-black ; opake ; lustre metallic ;
black ; cleavage not observable ; fracture uneven ; sus-
e of being cut with a knife. From Guanaxuato in
o. It occurs also at Guansamez in Durango, with calc-
nd copper pyrites.

RED SILVER.

er. Rhombohedral Ruby Blende, M. Rhomboidal Ruby Blende, J. Aerosite.

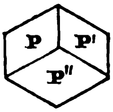
Joachimsthal.	
Silver	64 67
Arsenic	15·09
Sulphur	19·51
Antimony	0·69
	99·96 H. Rose.

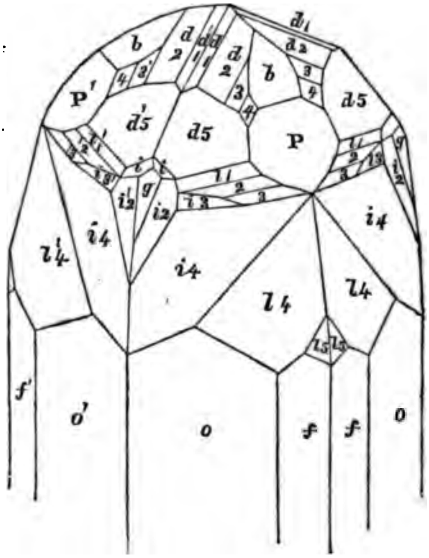
Sulphuret of silver	74·35
Sulphuret of arsenic	25·00
	99·35 Proust.

These two varieties also differ considerably in specific gravity, the light-red seldom exceeding 5·4 — 5·6, while that of the dark-red amounts to 5·8 — 5·9. They however correspond so entirely in their crystalline form, and, with the above exception, so perfect an analogy exists in all their physical characters, that mineralogists do not generally concur in separating them into distinct species. They have not been separated by Mohs or Brooke. The chemical formula given by Bonsdorff, answering to his own analysis, is $3AgSl^2+2StSl^3$. Rammelsberg includes the analysis by Rose under the same species, and, supposing the isomorphic replacement of the antimony by the arsenic, gives a formula which includes both varieties.

It occurs crystallized in a great variety of forms, also dendritic, massive, and micaceous; structure lamellar; mechanically divisible into an obtuse rhomboid of 108° 30′ and 71° 30′, — the primary form, — but its extreme brittleness renders this difficult.

Primary.





The above figure represents a crystal in the possession of H. J. Brooke, Esq. This crystal, perhaps one of the most complex that has been observed, confirm the observation already annexed to the rhomboidal figure anying the notice of calcareous spar, viz. that the modifications to the rhomboid is liable, are almost endless. The planes *b* of the above tend, by their extension, to produce a rhomboid more obtuse than mary, the planes *g* to acute rhomboids: the planes *d*1, 2, 3, 4, and 5, production of obtuse dodecahedrons; all the planes *i* and *l* to acute hedrons: *o o* and *f f* to regular six-sided prisms.

′	108°	30′		*i*2 on *i*2′	157°	20′
. . . .	172	0	*c. g.*	— — *g*	168	10
1 or P′ on *d*1′ .	164	15		*i*3 on *i*3	151	15
2 or —— *d*2′ .	167	43		*i*4 on *i*4	134	40
4 or —— *i*4′ . .	141	50		*l*1 on *l*2	178	50
3 or —— *l*3′ . .	163	0		*l*2 on *l*3	179	0
4 or —— *l*4′ . .	158	22		*l*2 on *l*2	148	32
or —— *o*′ . .	126	10		*l*3 on *l*3	153	17
2	164	50		*l*4 on *l*4	141	20
2′	132	55		*l*5 on *l*5	173	30
5	155	0	*c. g.*	*o* on *o* or *o*′	120	0
5′	125	0				

aries by reflected light from lead-grey to iron-black, by nitted light from brilliant to dark red; semi-transparent ake; lustre imperfect-metallic in dark-colored varieties, antine in such as are light; streak different shades of neal-red, according to the color; cross fracture conchoi-ith a shining lustre; sectile, yielding readily to the knife. on charcoal it first decrepitates, fuses, emits fumes of sulphur and antimony, and ultimately leaves a globule of silver. le without effervescence in nitric acid.

is very beautiful mineral is confined to a small number of been observed that the dark yield a larger proportion of silver than the light varieties, but both of them are highly valuable to the smelter.

MIARGYRITE.*

Hemi Prismatic Ruby-Blende, M. Miargyrite, *Prof. H. Rose.* Bisulpho-antimoniate of Silver, *Thomson.* Rubella obliqua, D.

Combination of silver, antimony, and sulphur, in proportions different from those of the preceding species.

	Braunsdorff.
Silver	36·40
Antimony	39·14
Sulphur	21·95
Copper	1·06
Iron	0·62
	99·17 H. Rose.

The formula from this analysis, as given by Rammelsberg, is $\overset{\prime}{A}g\overset{\prime\prime\prime}{S}b$. This requires 35·86 Ag, 42·79 St, 21·35 Sl.

Sp. Gr. 5·2 — 5·4. H. = 2 — 2·5.

Primary form an Oblique rhombic prism of 93° 56′, and 86° 4′, and whose base is inclined to its axis at an angle of 101° 6′. Imperfectly cleavable in the direction of the larger diagonal of the base. Color iron-black; opake, except when viewed by transmitted light, in which case thin fragments present a deep blood-red hue; lustre intermediate between metallic and adamantine; streak dark cherry-red; fracture imperfect conchoidal; surfaces of the crystals deeply striated; very sectile. B B, alone on charcoal it fuses with abundant white vapors, which have occasionally a slight alliaceous odor, leaving a globule of silver. It is soluble in nitric acid, with an immediate white antimonial precipitate.

This very rare mineral used to be comprised among the varieties of dark-red silver, until distinguished by reason of its form, and described by Mohs. It occurs with argentiferous arsenical pyrites, in one of the mines of Braunsdorff, near Freyberg in Saxony.

STROMEYERITE.

Sulphuret of Silver and Copper. Argent et Cuivre Sulfuré, *Bournon.* Silberkupferglanz, *Stromeyer.* Stromeyerine, *Beudant.* Argentiferous Copper Glance, J. Argentiferous Sulphuret of Copper, A. Cuivre Sulfuré Argentifère, *Levy.* Sulpho-cuprite of Silver, *Thomson.* Lunites Cupricus, D.

This mineral consists of copper, silver and sulphur, in the following proportions:

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* From μειων, *less*, and ἀργυρος, *silver*, because it contains less silver than some of the analogous ores.

	Schlangenberg.	Atoms.
Copper	30·478	7·62
Silver	52·272	3·80
Sulphur	15·782	7·84
Iron	0·333	0·00
	98·865 Stromeyer.	

e atoms of copper are twice as numerous as those of sil-
nd it is thus obvious that the mineral is composed of one
sulphuret of silver, two atoms disulphuret of copper.
ula: $AgSl+2Cp^2Sl$.

Sp. Gr. 6·25. H. = 3·0 — 4·0.

ystalline form unknown. Occurs compact; color steel-
with a metallic lustre; the surface produced by fracture
brilliant, granular, and partially conchoidal; very brittle,
eadily fusible B B, emitting sulphuric acid fumes, and
ng a grey globule with a metallic lustre. With the fluxes
ibits the re-action of copper, and on the cupola yields a
globule of silver.

ccurs associated with copper pyrites, calcareous spar,
ornblende, at Schlangenberg near Colivan in Siberia. It
ery rare mineral, and was first examined and recognised
eculiar species, by Stromeyer, from specimens in the
um of Gottingen.

BISMUTHIC SILVER.

h Silbererz, *Selb.* Bismuthic Silver, J. A. Bismuth Sulfuré Plumbo-Argentifère. *Levy.* Bismutum Argenticum, D.

nsists of bismuth 27·0, lead 33·0, silver 15·0, iron 4·3, The constitution, as given by Rammelsberg, is one atom silver, and one atom selenium, or AgSel.

Sp. Gr. 8·0. H. = 2·5.

Occurs in very thin veins traversing seleniuret of lead, at Tilkerode in the Hartz, from which mineral it is distinguished by its being of a darker hue. Possesses three cleavages perpendicular to one another.

Color iron-black; streak unaltered; lustre metallic, splendent; opake. Structure foliated. It exhibits three cleavages perpendicular to each other, so that its primary form is the Cube. The thin-plates are covered with a brass-yellow metallic substance, which seems to be copper pyrites. Malleable, but not so much so as sulphuret of silver. When heated in a glass tube it melts, and gives off a small sublimate, consisting partly of selenium and partly of selenic acid. It gives out a strong smell of selenium. B B, on charcoal, it melts silently in the exterior flame, with frothing in the interior flame. It glows, on cooling, almost as distinctly as magnetic pyrites. With carbonate of soda on charcoal it is reduced. The globule is shining as long as it is hot, but on cooling becomes covered with a black coating; if borax be added, it retains the metallic lustre after cooling. It is silver-white, very malleable, and behaves like pure silver. Very soluble in smoking nitric acid, but it dissolves with difficulty in dilute nitric acid.

EUKAIRITE.*

Seleniuret of Silver and Copper. Selen Kupforsilber, L. Cuivre Selenié Argental, H. Selenio-cuprate of Silver, *Thomson*. Lunites Selenicus, D.

It is a compound of seleniuret of silver and copper:

		Atoms.	
Selenium	26·00	5·2	1·84
Copper	23·05	5·61	1·98
Silver	38·93	2·83	1·00
Earthy matter	8·90		
	96·88 Berzelius.		

These numbers give very nearly two atoms selenium, two atoms copper, one atom silver; or one atom disileniuret of copper, one atom seleniuret of silver. Formula, according to Berzelius: $Cp^2Sel+AgSel$.

Color shining lead-grey, texture granular; massive; disposed in thin superficial black metallic films, staining the calcareous spar in which it is contained. B B, it exhales a strong odor of selenium, and on charcoal fuses readily into a grey

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* Eukairite, from the Greek, signifying *opportune*; in allusion to its discovery just as Berzelius had completed his examination of selenium.

ic globule, which is not malleable. To borax or salt of
horus, it imparts a green color in the oxidating flame,
es colorless in the reducing one, and on hardening ap-
opake and of a cinnabar-red hue. Is soluble in heated
acid, and when cold water is added to the solution it
a white precipitate.

s extremely rare mineral was discovered and analyzed by
ius. It occurs in a copper mine at Skrickerum in
nd, Sweden, with carbonate of lime, serpentine, seleni-
copper, and copper pyrites.

IODIDE OF SILVER.

ilver. Iodure d'Argent, *Necker.* Iod-Silber, *Leonhard.* Ceratus foliatus, D.

ontains silver, lead, iron, iodine, and sulphur; but the
tions do not appear to have been accurately determined.

H. about 1·0.

urs massive, in thin plates of a greyish-white or silver-
color, which change to lavender-blue on exposure to the
Transparent or translucent; lustre resinous, passing into
ntine; malleable and flexible in thin laminæ; streak
etallic. Soluble in heated muriatic acid, which it colors
n-brown, disengaging, after a short time, violet-colored
B B, on charcoal, it instantly melts, and produces a
which tinges the flame of a beautiful violet-hue, globules
er at the same time appearing on the charcoal.

found at Albarradon near Mazapil in Mexico, and forms tively rare at Huelgoeth. More recently it has been brought from the department of Copiapo, province of Coquimbo, in Chili, and in a fibrous form, consisting apparently of elongated prismatic crystals not very firmly cohering. We are yet without a full description of this rare mineral.

CARBONATE OF SILVER.

Argent Carbonaté, H. Grey Silver Ore, J.

Consists of silver 72·5, carbonic acid 12, oxide of antimony and a trace of copper 15·5 — *Selb.* It is doubtful whether the carbonic acid is really combined with oxide of silver.

It is of a greyish color, passing into iron-black; it occurs massive and disseminated; the fracture is fine-grained and somewhat uneven, with a glistening metallic lustre; it is soft, brittle, and heavy. It is almost instantaneously reduced B B; and effervesces with nitrous acid.

This species was observed many years ago by M. Selb, in veins traversing granite in a mine at Altwolfach, in the Black Forest, accompanying native silver, sulphuret of silver, and barytes; but not having again occurred, its properties are indistinctly defined. It has since been found at Real de Catorce in Mexico.

CHLORIDE OF SILVER.

Muriate of Silver. Horn Silver. Hornerz, W. Argént Muriaté, H. Bt. La Mine Corne, Br. Corneous Silver, J. Hexahedral Pearl Kerate, M. Chlorsilber, *Berzelius.* Chloride of Silver, A. Ceratus cubicus, D.

Combination of chlorine and silver.

	Saxony.	Peru.
Silver	67·75	76·0
Chlorine	21·50	24·0
Oxide of iron	6·00	0·0
Alumina	1·75	0·0
Sulphuric acid	0·25	0·0
	103·25 Klaproth.	100·0 Klaproth.

The first was an impure specimen; but the second answers almost exactly to one atom chlorine, and one atom silver. Formula: AgChl.

Sp. Gr. 4·75 — 5·55.

Primary form the Cube, occurring with edges and solid angles replaced; sometimes in perfect octahedrons. Of a pearl-grey, greenish, or reddish-blue, but commonly tarnished externally of a brown color; it occurs massive, also investing other substances, and crystallized in small cubes and acicular prisms; feebly translucent or opake, with a glistening or waxy lustre; yields to the pressure of the nail, and is malleable and sectile; cleavage none; fracture conchoidal. It is fusible in me of a candle. B B, on charcoal, it is reducible to a ic globule, emitting at the same time vapors of muriatic when rubbed with a piece of moistened zinc, the surface es covered with a thin film of metallic silver. Insoluble ic acid.

ccurs in veins chiefly in primitive rocks, with some of her ores of silver. The largest masses, and particularly of a green color, are brought from Peru and Mexico. It o be found in considerable quantities in the Saxon minstricts of Freyberg and Johanngeorgenstadt, but it is now carce. It also occurs in Siberia, in Cornwall, and at oet in Brittany. Fine masses were noticed by Mr. , at the mines of Chinasilla in Chili, and at those of ayja and Santa Rosa in Peru.

TERMILK SILVER. — Buttermilch silber, W. Earthy corneous J. Silver 24·64, muriatic acid 8·28, alumina 67·08. — *Klaproth.* considered an earthy variety of the above species. It is commonly nassive, and investing other substances; is opake, and dull, with an fracture, and is soft, sectile, and heavy. It occurs only at Anerg in the Hartz, in veins traversing transition rocks.

GANSEKOTHIG-ERZ.*

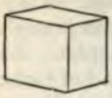
Chenocopsolite. Arealus Argentiferus, D.

An arseniate of silver and iron.

H. = 2·0 — 3·0.

rregularly mammillated translucent masses of a yellow or reen color. Shining, with white streak, resinous lustre, onchoidal fracture; sometimes earthy, and mixed with form; often in macles; also capillary, dendritic, in thin plates filling crevices, and massive; no regular structure; tough, malleable, flexible, and sectile. B B, it fuses into a bead of apparently pure copper. Soluble in nitric acid, which it colors green; and in ammonia, to which it gives a fine blue tinge. Isolated and rubbed, it acquires vitreous electricity. Fusible at 27° Wedgewood.

1.



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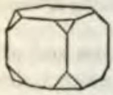

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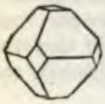

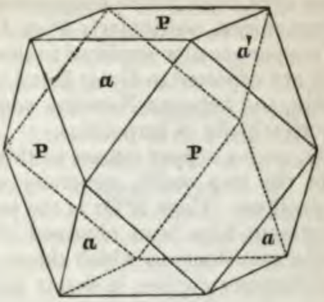

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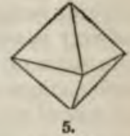

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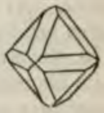

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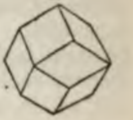
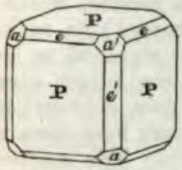


Fig. 1, a cube. Fig. 2, the same, of which the solid angles are replaced by triangular planes, which in fig. 3 are so greatly enlarged as to have become six-sided, reducing the planes of the cube to small quadrangles. The triangular planes of fig. 2 are complete in fig. 4; — the regular octahedron. Fig. 5, an octahedron of which the edges are replaced, forming a passage of that solid into the rhombic dodecahedron, fig. 6, in which the planes replacing the edges of fig. 5 are complete.



P on P or P	90°	0′ H.
P P or P on *a′* or *a*	125	15 —
—— —— *e′* or *e*	135	0 —
a′ on *a* or *a*	109	28 —
e′ on *e* or *e*	120	0 —

The most splendid crystalline varieties of native copper are those of Siberia, and the island of Nalsoe in Faroe, where it accompanies fibrous mesotype in amygdaloidal trap. Some very singular crystallizations, produced by the elongation of the simple individual, occur at Moldawa in the Bannat, at Chessy in France, Herrengrund in Hungary, and elsewhere. Cornwall, however, is certainly the greatest depository of native copper; and many of the mines near Redruth, the Con-

ted Mines, Wheal Buller, and some others, afford it in
derable quantities. Its crystals are rarely regular, their
being disproportionately enlarged, and they are generally
ed in branches formed by the union of these crystals in
in a manner analogous to the crystalline structure of
silver. — *Allan's Manual.*

tive copper is common to the mines of South America, as
e Cordilleras of Atacama and in Chili, where masses
ing several hundred pounds have been obtained. Large
ery beautiful crystals of native copper have been brought
some of these mines, particularly from Coquimbo. Ex-
e mines of copper are now explored in the island of Cuba,
res of which are exported to Great Britain and the United
s. At Gibara, and between Neuvitas and Principe, these
are found principally in serpentine.

Nova Scotia, native copper occurs in thin seams and mi-
filaments in the trap rocks, generally with quartz, but
times with zeolites. Cape D'Or is the principal locality,
detached masses have been obtained of twenty pounds
ight. As the sandstone on which these trap rocks rest,
ins beds of vitreous copper, it seems probable that the
us rock, when forced up, carried with it portions of the
which were thus reduced to the metallic state.

cording to Prof. Silliman, a mass of native copper, weigh-
bout ninety pounds, was found many years since, on the
den Hills, near New Haven. It adhered to the surface of

do not occur in any instance in the shape of true veins in New Jersey. The mining has therefore been very precarious, and has never proved a source of profit.* More success is promised from the exploration of the mines of Michigan, which, according to Dr. Houghton, extend over a district of a hundred and thirty miles in length, and closely resemble, in the character and contents of the veins, the noted mines of Cornwall.† They occur in slate, conglomerate, and trap rocks. The mass of native copper, recently brought from the Ontonagon River, near Lake Superior, by order of the Secretary of War of the United States, weighs between three and four thousand pounds, is four and a half feet in length, and about two feet thick. It seems to have been a bowlder long since detached from its native bed, and the fragments of rock now adhering to it, seem to show that it was once connected with serpentine. This is the most extraordinary mass of copper of which we have any knowledge; and according to Mr. Schoolcraft it has been a subject of historical notoriety for upwards of one hundred and eighty years. It is now deposited in the museum of the National Institute, Washington. The native copper from Keween Point, on Lake Superior, is found exclusively in the amygdaloid and greenstone of the trap formation.

SULPHURET OF COPPER.

Vitreous Copper. Kupfer Glanz, W. Cuivre Sulfuré, H. Bt. Cuivre Vitreux, Br. Copper Glance, J. Prismatic Copper Glance, M. Cyprites rhombicus, D.

Combination of copper and sulphur.

	Siberia.	Cornwall.	Siegenschen.	Nova Scotia.
Copper	78·50	77·16	79·50	79·5
Sulphur	18·50	20·62	19·00	18·0
Iron	2·25	1·45	0·75	2·5
Silica	0·75	0·00	1·00	0·0
	100·00 Klaproth.	99·23 Thomson.	100·25 Ullman.	100·0 C. T. Jackson.‡

Each of these analyses approaches very nearly to one atom sulphur, and two atoms copper. The mean of the whole is 19·66 At. copper, 9·52 At. sulphur. It is therefore a disulphuret, its formula being Cp^2Sl.

Sp. Gr. 5·69 — 5·8. H. = 2·5 — 3·0.

Color lead- or iron-grey, often tarnished black, and occasionally iridescent. According to Haüy and Levy, the primary form is a Regular hexagonal prism, in which, either perfect or modified on its lateral and terminal edges, it usually occurs. The prisms are of various length, and the replacements on the terminal planes, give rise to acute and obtuse double six-sided pyramids, which also occur complete. All the solid angles of the prism may be removed by a knife, so as to produce a double six-sided pyramid with brilliant planes, the incidence of an upper on the adjacent plane of the lower pyramid, being about 147° 30′. But, according to Brooke, the primary form of this species is a Rhomboid, P P″=71° 30′ very nearly; the cleavage being parallel to the hexagonal pyramids corresponding to the primary plane.* It is occasionally in pseudomorphous crystals. Structure perfectly lamellar; fracture often conchoidal, with a vitreous lustre; the massive varies greatly in respect of hardness and color; it is sometimes sectile and soft. B B, on charcoal, it disengages the odor of sulphurous acid; in the oxidating flame it fuses readily; in the reducing it emits sparks; and when the sulphur is wholly driven off, it yields a bead of copper. In ammonia it forms a blue solution. In heated nitric acid the copper is dissolved, and the solution assumes a green color, but the sulphur remains.

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* Report on the Geology of New Jersey, p. 159, by Henry D. Rogers.

† Fourth Annual Report on the Geology of Michigan, p. 77, by Douglass Houghton.

‡ Mineralogy and Geology of Nova Scotia, by Messrs. Jackson and Alger, p. 76. Also Am. Journ. of Science, xv. 154.

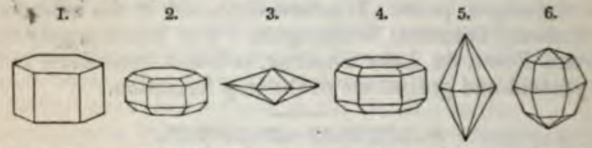
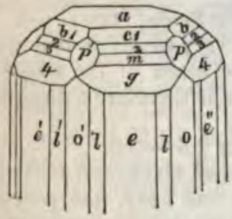


Fig 1, the most simple of its forms; a six-sided prism. Fig. 2, the same, of which the terminal edges are replaced by planes tending to obtuse six-sided pyramids; which are complete in fig. 3, a flat six-sided pyramid. Fig. 4, a six-sided prism of which the terminal edges are replaced by planes tending to acute six-sided pyramids; which are complete in fig. 5. Fig. 6 represents a crystal consisting of portions of the planes of the acute pyramid, fig. 5, terminated by the obtuse pyramidal planes of fig. 3.



a on b1 or c1	146°	30′
—— b2 or c2	137	40
—— b3 or c3	135	30
—— b4 or g	116	40
—— e, e′ or e″	90	00
—— p or p′	130	00 c. g.
e on e′ or e″	120	00
e or e′ on o′	150	00
e on l or e′ on l′	168	34

The sulphuret is met with in veins and beds accompanying other ores of copper, and is highly prized by the miner. The crystallized varieties occur abundantly, and almost exclusively, in the mines of Cornwall, and particularly in those near Redruth; while the more compact and massive are found also in

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* Article Mineralogy, Encyclopædia Metropolitana, p. 488.

Siberia, Hessia, Saxony, and the Bannat. In Nova Scotia, it forms beds in red sandstone, interstratified with bituminous coal and lignite, at Carriboo river, near Pictou.

In the United States, it occurs in red sandstone at the Schuyler mine, N. J., and at Simsbury and Cheshire, Conn. It is found in small quantities in Columbia and Dutchess counties, N. Y.; also in Orange county, Va. Specimens from Bellamy's mine, Cheshire, Conn., according to Shepard, are finely crystallized. At the lead mines of Wisconsin and Missouri, it forms an article of commercial value, and is smelted to a considerable extent.

The *argent en epis,* or cuivre spiciforme of Haüy, from Frankenberg in Hessia, is supposed to be vegetable matter impregnated with black sulphuret of copper.

Vitreous copper is readily distinguished from either bournonite or fahlerz by its comportment B B, and the green solution it produces with nitric acid; and from red silver ore by the color of its streak, which resembles that of the mineral, while red silver presents a fine cochineal red. — *Allan's Man.*

VARIEGATED VITREOUS COPPER. Cuivre sulfuré hépatique, H. Color that of tempered steel, violet-blue, greenish, and yellow. It seems to arise from an intimate mixture of the vitreous and yellow copper; both of which generally appear distinctly in the same specimen. It occurs in most of the mines of Cornwall in which vitreous copper is found.

INDIGO COPPER.

Kupferindig. Blue Copper. Covelline.

This mineral contains by the analysis of Walchner, copper 64·77, sulphur 32·64, iron 0·46, lead 1·04. The atoms of copper are 16·19, and the atoms of sulphur 16·32, showing the mineral to be a simple sulphuret. Formula: CpSl.

Sp. Gr. 3·8 — 3·82. H. about 2·0.

Occurs in spheroidal masses, presenting superficial indications of crystallization. Color indigo-blue or darker; opake, with a faintly resinous lustre, and a lead-grey shining streak. Sectile. B B, it burns, prior to becoming red hot, with a blue flame, and melts into a globule, which is strongly agitated, and emits sparks; finally, it yields a button of copper.

It occurs at Sangerhausen in Thuringia, imbedded in grauwacke, and is a rare mineral. It has also been discovered by Covelli* in the volcanic rocks of Vesuvius, in black or greenish-blue incrustations having the appearance of spiders' webs, deposited around the fumaroles of the crater Vesuvius, and

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* Whence it has been named Covelline by Beudant, in honor of the late Sig. Covelli of Naples.

sed to be derived from the action of sulphuretted hydro-
n the sulphate and muriate of copper. Is soluble in ni-
cid, with the disengagement of nitrous gas.

PURPLE COPPER ORE.

Copper. Buntkupfererz, W. Cuivre Pyriteux Hépatique, H. Variegeted Copper, J. Octahedral Copper Pyrites, M. Pyrites erubescens, D.

	Killarney.	Westmanland.	Cornwall.	St. Pancrasse.
hur	23·75	24·69	28·24	22·8
er	61·07	62·33	56·76	59·2
	14·00	11·80	14·84	13·0
a	0·50	0·16	0·00	0·0
ix	0·00	0·00	0·00	5·0
	99·32 R. Phillips.*	99·98 Hisinger.	99·34 Plattner.	100·0 Berthier.

e formula given by Berzelius, is $\acute{\mathrm{Fe}}+\acute{\mathrm{Ȼu}}^{2}$, which corres-
with the analyses by Phillips and Hisinger, requiring
copper, 23·89 sulphur, 13·43 iron.

Sp. Gr. 5·0. H. = 3·0.

occurs both massive and crystallized; color of the mas-
between copper-red and tombac-brown; in the crystal-
the latter color prevails, with an iridescent tarnish,
ally of blue, sometimes yellow. The general form of the
ls is that of the cube, of which the solid angles are re-
d, and the faces are mostly curvilinear; lustre metallic;
pale-greyish black, and slightly shining; not perfectly
lar, but manifestly yields to mechanical division parallel
planes of the Regular octahedron; in other directions
acture is imperfect conchoidal; it is soft, easily frangi-

crustations upon common pyrites copper, and is in kidney-shaped masses attached to bituminous shale. In the United States, it is found near Wilkesbarre, Penn., at Chesterfield, Mass., Walcottville and Litchfield, Conn.

GREY COPPER.

Tetrahedral Copper Pyrites, J. Tetrahedral Copper Glance, M. Fahlerz, W. Br. Cuivre Gris, H. Panabase, *Beudant.* Trisulpho-antimoniate of Copper, *Thomson.* Cyprites tetrahedrus, D.

Prof. H. Rose has analyzed seven very carefully selected specimens of this mineral, from different localities, and the results of five of these analyses are given below.—*Pogg. Ann.* xv. 576. The first is by Klaproth.

	Clausthal.	Dillenburg.	Alasce.	Freyberg.	Furstenberg.	Clausthal.
Copper	37·50	38·42	40·60	14·81	25·03	34·48
Arsenic	0·00	2·26	10·19	0·00	0·00	0·00
Antimony	29·00	25·27	12·46	24·63	26·63	28·24
Iron	6·50	1·52	4·66	5·98	3·72	2·27
Sulphur	21·50	25·03	26·83	21·17	23·52	24·73
Silver	3·00	0·83	0·60	31·29	17·71	4·97
Zinc	0·00	6·85	3·69	0·99	3·10	5·55
Silica	0·00	0·00	0·41	0·00	0·00	0·00
	97·50	100·18	99·44	98·87	99·91	100·24

In each of the above analyses the atoms of sulphur and metallic bases are nearly balanced, indicating a simple combination of atoms among these constituents. As viewed by Dr. Thomson, this mineral consists essentially of one atom sulphide of arsenic and antimony, and three atoms sulphuret of copper. Formula: $(StAs)Sl+3CpSl$.* But in the last specimen, which consisted of pure tetrahedral crystals, the atoms of copper approach very nearly to thrice those of the antimony alone, so that the mineral appears to resolve itself into the simple constitution of one At. sulphuret of antimony, three At. sulphuret of copper. It will be observed that arsenic is contained in only two of the specimens analyzed. Formula: $StSl+3CpSl$.

Sp. Gr. 4·4—5.2. H. $=$ 3·0—4·0.

The marked diversity in their chemical composition, would seem to demand a separation of some of the varieties of the present species. Many of them, indeed, are readily distinguishable at first sight; but there are others which present such intermediate stages, as to render all attempts at reducing the differences to fixed limits impossible. Of a steel-grey or iron-black color; it occurs crystallized in the Tetrahedron, which is considered its primary form; also massive and disseminated; cleavage octahedral, imperfect; streak same color as the mineral, sometimes inclining to brown; fracture uneven or rfect conchoidal, with a shining or glistening metallic e; brittle. B.B. it disengages vapors of an arsenical or monial odor. With soda, after considerable roasting, it s a grain of metallic copper; and with borax presents the -green tinge characteristic of iron. It colors nitric acid ; and its powder, placed in that acid, soon becomes grey.

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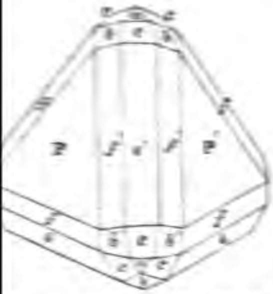
* In some of the analyses, there is a deficiency in the atoms of copper, which, to amount to thrice the atoms of antimony, is supplied by the iron, zinc and silver.

2.



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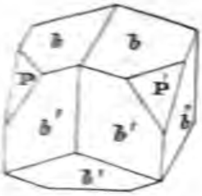

P'	70° 31′ H.	b or b on e	150° 00′ H.
P' on a	109 28 —	e or e on e	146 26 —
— on b or b' ...	144 44 —	e on f or e' on f' or f'.	144 44 —
— on e or e' ...	125 15 —	f' on f'	109 28 —
— on f or f' ...	160 31 —	f on f'	146 26 —
....	144 44 —	f or f' on b	150 00 —
or b	120 00 —		

above figures and measurements are given on the authority of Haüy.

and disseminated; the fracture fine-grained, uneven; yields easily to the knife, and is brittle. Specific gravity 4·5. It contains 40 per cent. copper, the remainder iron, arsenic, and sulphur. — *Henckel.* B B, it yields a white arsenical vapor, and melts into a greyish-black slag.

It accompanies other ores of copper at Huel Gorland, and elsewhere in Cornwall.

Platiniferous Grey Copper. A grey-colored variety, agreeing generally with fahlerz in external character, consisting, according to Vauquelin, of copper, lead, antimony, iron, silver, platina, and sulphur; was formerly found at Guadalcanal in Estremadura in Spain, where it occurs with ores of silver and arsenic.

TENNANTITE.*

Tennantite. (*Quarterly Journal of Science*, vii. 95.) Cyprites dodecahedrus, D.

This mineral has been analyzed by R. Phillips, and by Mr. Hemming, who obtained the following constituents:

Sulphur	28·74	23·00
Arsenic	11·84	12·10
Copper	45·32	50·00
Iron	9·26	15·00
Silica	5·00	0·00
	100·16 Phillips.	100·10 Hemming.

Beudant has thus given the formula founded on the analysis by Phillips: $9CpSl+(FSl^2+FAs^2)$. Dr. Thomson supposes the sulphur to be in combination with the arsenic and copper, and the iron in a state of silicate, and accidental. If it be thus considered, the mineral consists of one atom sulphuret of arsenic, and four and a half atoms sulphuret of copper. Formula: $AsSl+4\frac{1}{2}CpSl$.

Sp. Gr. 4·375. H. = 3.

Tennantite is usually found crystallized in the form of the rhombic dodecahedron, either perfect or variously modified; also in the cube and regular octahedron, of which the edges and angles are replaced; often very splendent; sometimes lead-grey, with but little lustre; occasionally approaching to iron-black and dull; fracture imperfectly lamellar and uneven; cleavage parallel to the planes of the dodecahedron; primary form the Octahedron, as is indicated by occasional striæ on the planes of the dodecahedral crystals parallel with their longer diagonal. Somewhat harder than the preceding: and is brittle. Its powder is reddish-grey. B B, on charcoal, it first burns with a blue flame and slight decrepitation, emits copious arsenical vapors, and ultimately fuses, leaving a greyish-black scoria, which affects the magnetic needle. After fusion it yields with soda a bead of copper. Soluble in nitric acid.

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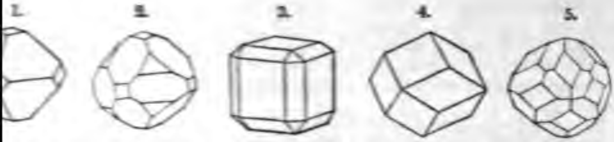
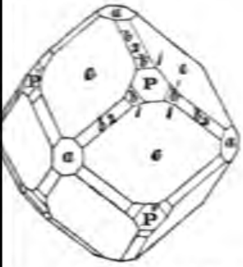
* In honor of the late excellent chemist, Tennant.



1, the regular octahedron, of which the solid angles are replaced. ; in this the edges also are replaced: the same planes appear on fig. g. 4, the rhombic dodecahedron. Fig. 5, the same, having its edges ced.



P on P′ or P″	109°	30′
—— *b*1	168	56
—— *b*2	161	30
a on *a*	90	00
—— *b*2	144	50
a on *e* or *e*	135	4
e on *e* or *e*	120	00

ennantite is a variety exclusively Cornish. It usually oc- in small but very splendent crystals, investing other ores opper, in veins which traverse granite and clay-slate, in al of the copper mines, as Dolcoath, Cook's Kitchen, and Croft near Redruth; and in Huel Virgin, Huel Jewel, Huel Unity near St. Day. The rhombic dodecahedron

	Furstenberg.	Cornwall.
Copper	33·12	30·00
Iron	30·00	32·20
Sulphur	36·52	35·16
Silica	0·39	2·64
	100·03 H. Rose.	100·00 R. Phillips.

	Lozere.	Lozere.	Lozere.
Sulphur	32·0	36·3	33·6
Copper	32·6	32·1	31·2
Iron	29·2	31·5	32·2
Earthy matter	3·2	0·0	1·6
	97·0 Berthier.	99·9 Berthier.	98·6 Berthier.

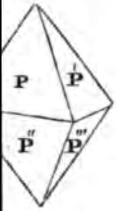
	Anglesea.	Cornwall.
Sulphur	35·01	34·65
Copper	32·95	33·64
Iron	32·01	31·53
Earthy matter	0·00	0·55
	100·00 Thomson.	100·37 Thomson.

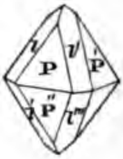
The analyses differ but little from each other, and the constitution plainly deducible from them, is two atoms sulphur, one atom copper, one atom iron. Formula: FSl+CpSl.

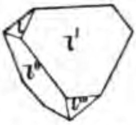
Sp. Gr. 4·16 — 4·3. H. = 3·5 — 4·0.

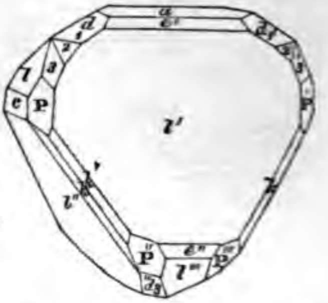
Color brass-yellow, but externally subject to tarnish, and often iridescent; the crystals present the general form of the tetrahedron, having the solid angles always replaced; the structure is perfectly lamellar, affording brilliant surfaces parallel to the planes of a somewhat Acute octahedron with a square base; so that the tetrahedron, as is shown in the following figures, is in fact only the remarkable consequence of an alternate enlargement of the planes *l*, modifying the edges of the primary octahedron; fracture conchoidal and splendent; lustre metallic; streak greenish-black, and somewhat shining; brittle. It also occurs stalactitic, botryoidal, mammillated, and amorphous, the latter being often variegated; the structure of the botryoidal is granular; these are harder than the crystallized varieties; brittle. Copper pyrites yields to the knife, and may hence be distinguished from iron pyrites, which it often greatly resembles; its color is generally also of a deeper yellow than that of iron pyrites. It fuses on charcoal B B, emits a sulphurous vapor, and melts into a brittle black globule, which finally attracts the magnet; with borax, in small proportion, it yields a copper bead; and with soda, after the sulphur is entirely roasted off, separate globules of iron and copper may be obtained. In dilute nitric acid it forms a green solution, a portion of sulphur remaining undissolved.

Primary.









P′	102°	30′	*d*1 on *d*1′.	133°	50′
P″ or P′ on P‴ . . .	125	30	*d*1 on *l*	143	24
*d*1 or P′ on *d*1′ . . .	150	50	*d*3 on *l*	144	10
*d*3 or —— *d*3′ . . .	169	32	*d*3 on *d*3′	111	40
, *l*′, or *l*″, or *l*′, *l*″, or *l*‴	141	15	*k* on *k*′	149	2
			l on *l*′ or *l*″	110	0
. . . .	126	0	—— *e* or *l*‴ on *e*′	144	25
*d*3, or *d*1′ on *d*3′ . .	160	54	*l*′ on *l*″	71	10

his is the most abundant variety of copper; nearly one of the ore obtained by metallurgical processes being exed from it, and in Great Britain yielding more metallic er than all the other ores of copper together. In Cornit occurs associated with tin, forming veins in killas, and mpanying buntkupferez, galena, grey copper, and blende.

furnished by the British Islands, and all the countries of the continent of Europe.—*Report on Cornwall, Devon, &c.*, p. 264. In Western Asia, according to the American missionaries, valuable copper mines are found in the mountain ridge west of Erzeroum, and are wrought by the Greeks.

In the United States there are several important localities of copper pyrites which have afforded fine crystals. These are principally in New York, as at the Rossie lead mines in St. Lawrence county, in tetrahedral and macled crystals, and Wurtzborough, Sullivan county, in nearly perfect octahedrons. In New Hampshire, it is abundantly disseminated through the great tremolite bed of Warren, in nodules and veins. It yielded Dr. Jackson, by assaying, thirty-one per cent. of pure copper. It also occurs in veins with pleisto-magnetic iron, at Franconia, in the same State. At Strafford, Vt., it is found in sufficient quantity for exploration and smelting, and very pure copper has for many years been obtained from it.

SELENIURET OF COPPER.

Seleniure de Cuivre, *Berzelius*. Cuivre Selenié, H. Berzeline, *Beudant*. Selen Cuprite, *Shepard*.

An analysis of this mineral by Berzelius gave,

		Atoms.
Copper	64	16
Selenium	40	8
	104	

It thus consists of two atoms copper and one atom selenium, or it is a diseleniuret of copper. Formula: Cp^2Sel.

In masses, having an impalpable composition, and of a silver-white color; streak shining; lustre metallic; soft, and admits of being smoothed down and polished, assuming then the color of tin. Isolated and rubbed, it acquires resinous electricity, B B, it fuses into a grey globule, which is slightly malleable, emitting, at the same time, powerful fumes of selenium; in the open tube yields selenium, which sublimes in the form of a red powder. With soda, after a lengthened roasting, it affords a a grain of copper. Is decomposed by nitric acid, and the solution deposits metallic copper on a plate of iron. The decomposition which this substance undergoes from exposure to the air, gives it a black color; and is therefore generally found in the form of black dendritic delineations, or in minute seams, traversing calcareous spar, at the copper mine of Skrickerum in Smaland, Sweden.

RED OXIDE OF COPPER.

Oxydulated Copper. Rothkupfererz, W. Cuivre Oxydulé, H. Cuivre Oxidé Rouge, Br. Octahedral Copper Ore, M. and J. Ziguelino, *Beudant.* Rutilus octahedrus, D.

It is composed as follows:

	Cornwall.	Siberia.
Copper	88·5	91·0
Oxygen	11·5	9·0
	100·0 Chenevix.	100·0 Klaproth.

The analysis by Chenevix, gives nearly the exact numbers required to constitute suboxide of copper, (two atoms metal, one atom oxygen), viz., copper 88·78, oxygen 11·22, according to Berzelius. Symbol: $\underline{\mathrm{C}}\mathrm{p}$ or $\dot{\mathrm{C}}\mathrm{u}$.

Sp. Gr. 5·6—6·1. H.=3·5—4·0.

The color of this mineral is red of various shades, by transmitted light sometimes crimson-red. It occurs crystallized in the form of the octahedron and its modifications, which are very numerous. The crystals are externally splendent, occasionally iridescent; or superficially of a lead-grey color, with a metallic lustre; and sometimes nearly black and dull. Structure lamellar; cleavage much interrupted, and not easily obtained, parallel to the faces of the Regular octahedron, which therefore is considered its primary form; fracture uneven, more often conchoidal, with a splendent and somewhat adamantine lustre; transparent or translucent; yields easily to the knife; and is brittle. Streak several shades of brownish-red, and shining. B B, it is reducible on charcoal to the metallic state, and with borax fuses readily into a fine-green glass. Soluble with effervescence in nitric acid, disengaging nitrous gas, and coloring the solution green; it may thus be distinguished from red silver ore, which does not effervesce in nitric acid, and from cinnabar which does not dissolve in it.

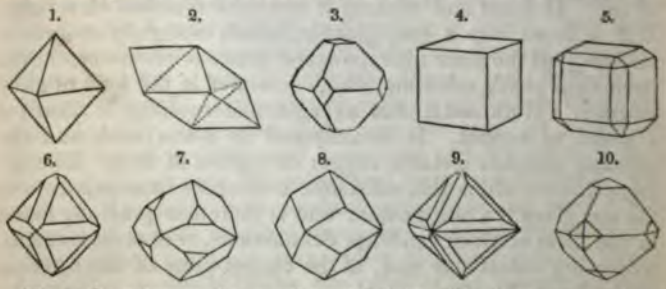
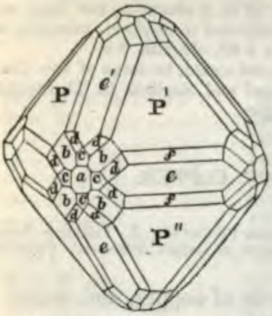


Fig. 1, the primary; the regular octahedron. Fig. 2, an acute rhomboid, arising, as will be perceived by the dotted lines, from an increase of crystalline laminæ on two opposite and parallel planes of the octahedron, the laminæ progressively diminishing to a point. Fig. 3, an octahedron, of which the solid angles are replaced by quadrangular planes; these planes meet and are complete in fig. 4, forming the cube. Fig. 5, the cube, having its edges and solid angles replaced. Fig. 6, an octahedron whose edges are replaced by six-sided planes; which, in fig. 7, are increased; and in fig. 8 complete, forming the rhombic dodecahedron. Fig. 9, an octahedron, of which each edge is bevelled by two planes. Fig. 10, an octahedron, of which each solid angle is replaced by four triangular planes, forming an obtuse pyramid on each. The varieties arising from combination of the planes exhibited in the above figures, are very numerous. The author has enumerated over one hundred.



P on P′ or P″	109°	30′
P P′ or P″ on *a*	125	10
———————— *b*	160	42
a on *b*	144	38
e on *e* or *e*′	120	00

Particularly translucent varieties of this species, presenting numerous modifications of the octahedron, occur with native copper and quartz in Huel Gorland, and other mines in Cornwall. Isolated crystals, sometimes an inch in diameter, are met with imbedded in lithomarge, at Chessy, near Lyons, generally coated or intimately mixed with the green and blue carbonates; and many splendid specimens are brought from Moldawa in the Bannat, and Ekatherineburg in Siberia.—*Allan's Manual.* According to De la Beche, red oxide of copper is rarely found in Cornwall or Devon, in sufficient quantities to form a mineral of much mining importance, and the same may be said of the carbonates and of native copper, the great product being from the sulphuret.

In the United States, at the Sommerville mine, N. J., both cubic and octahedral crystals of this mineral, were noticed by Prof. Nuttall. It is found also at the Schuyler, Flemington and New Brunswick mines, massive and imperfectly crystallized, associated with native copper and the carbonates. At the Perkiomen lead mine, Penn., in small translucent capillary and octahedral crystals, in red sandstone. This mineral was observed by Dr. Houghton, in considerable quantities, mixed with various other copper ores, in the mineral region of Michigan, recently explored by him. But he did not meet with it in a crystallized form.

illary Red Oxide of Copper. This differs from the pre- only in consisting of extremely slender transparent or translucent s; they are chiefly quadrangular prisms or elongated octahedrons, appear reticulated or variously aggregated, and sometimes fibrous. found in most of the mines of Cornwall in which the crystallized occurs; and at Rheinbreitbach on the Rhine, where it presents scarlet colors and a silky lustre.

ruginous Red Oxide of Copper, Zieglerz, or Tile Ore, to the earthy varieties. Externally it is of a brick-red or reddish- color; internally sometimes of a dark metallic grey, and then nearly t and hard; more commonly the fracture is earthy. Yields to the sometimes to the nail, and is opake. B B, it blackens, but does not A specimen from Lebanon, Penn., afforded to Seybert, suboxide of 43·88, protoxide of iron 42·16, water 6·98, alumina 3·80.* found, but not plentifully, with the red oxide, in some of the Cor- ines; also in the Bannat, at Camsdorf and Saalfeld in Thuringia, sewhere. It is a valuable ore of copper.

BLUE CARBONATE OF COPPER.

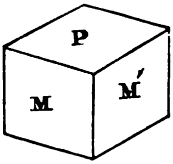
AZURITE.

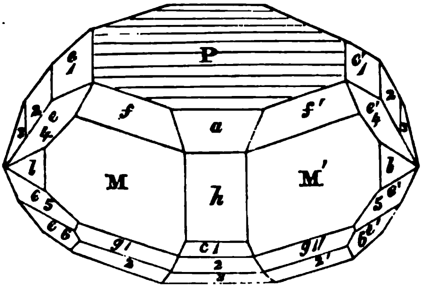
azur, W. Cuivre Carbonaté Bleu, H. Azure Copper Ore, J. Prismatic Azur chite, M. Azurite, *Beudant.* Hydro-carbonate of Copper, *Thomson.* Cypralus eus, D.

nbination of carbonic acid, oxide of copper, and water.

	Chessy.	Bannat.	Siberia.
e of copper	69·08	68·08	70·0
onic acid	25·46	25·00	24·0
r	5·46	6·05	6·0
	100·00 R. Phillips.	100·03 Vauquelin.	100·0 Klaproth.

Primary.





P on M or M′	91°	30′	M on *g*1 or M′ on *g*′1	142°	56′
M on M′	98	50	—— *g*2 or —— *g*′2	131	4
P on *a*	135	15	—— *h* or —— *h*	139	15
—— *e*1 or *e*′1	149	20	—— *l* or —— *l*	179	26
—— *e*2 or *e*′2	138	12	*a* on *f* or *f*′	139	30
—— *e*3 or *e*′3	119	30	—— *h*	136	45
—— *e*4 or *e*′4	115	30	*c*1 on *e*2	169	2
—— *f* or *f*′	112	15	—— *e*4	141	6
—— *h*	92	15	—— *f*	129	0
M or M′ on *a*	123	40	*e*3 on *e*′3 over P	120	30
M ou *e*1 or M′ on *e*′1	111	5	—— *e*5	157	5
—— *e*2 or —— *e*′2	116	55	*g*1 ou *g*2	168	15
—— *e*4 or —— *e*′4	149	5	—— *e*6	164	24
—— *e*5 or —— *e*′5	156	5	*h* on *c*1	154	4
—— *e*6 or —— *e*′6	138	30	—— *c*2	134	55
—— *f* or —— *f*′	159	50	—— *c*3	115	0

B B, it blackens, decrepitates, and ultimately fuses; with borax on charcoal it effervesces, and colors the flux green. It is soluble with effervescence in nitric acid.

It occurs in the veins of primitive and secondary mountains, chiefly with the green carbonate and red oxide of copper. Chessy, near Lyons, is the principal locality of this beautiful mineral; it is there met with in considerable abundance, and under a great variety of crystalline form. Very fine crystals occur in Siberia; while those from Moldawa in the Bannat, though of smaller size, are often extremely distinct. Huel Buller, near Redruth in Cornwall, has also afforded some fine crystallized varieties; and at Alston-Moor and Wanlockhead small quantities are occasionally met with. It is found massive, and of a smalt-blue color, in Cornwall; compact and earthy in Siberia and Thuringia; and in amorphous rounded concretions, sometimes of considerable dimensions, at Chessy. When obtained in sufficient quantity it is a valuable ore of copper. In the island of Cuba, fine blue and green carbonates of copper accompany both the red oxide and the native metal, as at Gibara and Neuvitas. In Nova Scotia, they occur in red sandstone, with vitreous copper, on the Cariboo River, conjointly with beds of lignite.

In the great copper district of Michigan, so well described by Dr. Houghton, green and blue carbonates of copper, associated with pyritous copper and the native metal, form veins in trap rock and conglomerate. In Wisconsin and Missouri it is found in the same limestone which contains the lead. It occurs in most of the copper mines in New Jersey imperfectly crystallized; also at the Perkiomen lead mines, Penn., in small but perfect crystals. It has other localities, as in Connecticut and Massachusetts, but is a rare mineral in the United States.

GREEN CARBONATE OF COPPER.

MALACHITE.*

Hemi-Prismatic Habroneme Malachite, M. Green Carbonated Copper. Malachite, J. Atlaserz. Mountain Green. Malachit, W. B. Cuivre Carbonaté Vert, H. Hydrous Dicarbonate of Copper, *Thomson.* Cypralus vulgaris, D.

Combination of carbonic acid, oxide of copper and water.

		Siberia.	Siberia.	Chessy.
Oxide of copper	70·5	70·10	72·2	72·69
Carbonic acid	18·5	21·25	18.5	19·98
Water	11·0	8·75	9·3	7·31
	100·00 Klaproth.	100·00 Vauquelin.	100·0 R. Phillips.	99·98 Thomson.

These analyses, the last two most nearly, approach to two atoms oxide of copper, one atom carbonic acid, one atom water. It is therefore a hydrous dicarbonate of copper, as thus expressed by the formula: $\underset{.}{C}p^2\dot{C}+Aq$.

Sp. Gr. 3·5 — 4·0. H. = 3·5 — 4·0.

Color various shades of green. Occurs in slender fibres, which sometimes are fasciculated, sometimes stellated; in the cavities, however, extremely minute and transparent crystals may occasionally be observed, which in reality are macles, as shown by the following figures; of these, the primary is a Right oblique-angled prism, yielding to cleavage readily parallel to the planes P and M, with difficulty parallel to T; transparent or translucent, sometimes only on the edges; lustre adamantine, inclining to vitreous; streak green, rather paler than the color; brittle. B B, it decrepitates, and fuses in part into a black scoria; with borax it readily affords a bead of copper, and colors the flux green. In the matrass it yields water; and is entirely soluble in nitric acid.

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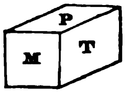
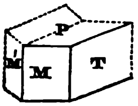
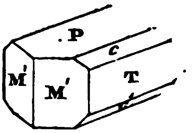
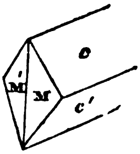
* Malachite, from the Greek; Marsh Mallow; the color of both being green.









P on M, M', or T	90° 00'	M on *c* or *c'*	112° 33'
M' on M	123 35	*c* on *c'*	107 16

The *fibrous* and *massive*, into which this species has been divided, is not a distinction of any consequence, as they run so insensibly into one another, that it is frequently difficult to ascertain to which of them a specimen should be referred. The crystallized variety is extremely rare, having been observed only in minute transparent twins, coating the cavities of the more fibrous kinds. Exteriorly it assumes globular, reniform, botryoidal, and stalactitic shapes, and occurs in the same repositories as the last species. Splendid specimens of the fibrous variety are found in Siberia, at Chessy in France, in the old mine at Sandlodge in Shetland, and disseminated in iron ore at Moldawa, in the Bannat. Compact malachite is chiefly known from Schwatz in the Tyrol; though in small quantities, it also occurs accompanying the blue carbonate in Cornwall, Wales, Ireland, and many other places. The green carbonate is a valuable ore of copper, and, from its variegated appearance, and the brilliant polish of which it is susceptible, is prized by the lapidary for ornamental purposes. Such varieties as are sufficiently compact, are cut into vases, snuff-boxes, &c.; and in St. Petersburg it is formed into tables, and other magnificent articles of luxury; for this purpose, as the malachite rarely occurs in slabs exceeding a foot square, the pieces are united so as to render the concentric lines of the stone continuous, and thus massive tablets of six or seven feet in length are formed of apparently one piece of this beautiful substance. Some varieties are used as pigments, and in the preparation of the sulphate of copper. — *Allan's Manual.*

On the estate of Von Demidoff, not far from the Nadeshnish shaft, Siberia, was found a considerable mass of malachite, reposing on brown iron-stone, and to the west, resting on a soft diorite-slate. As it was proved that the malachite bed must extend forty fathoms (280 English feet), the site of its principal mass was aimed at, and found in May, 1835. The malachite now lies uncovered for thirty-six fathoms, and presents, in one place, an immense solid mass of about forty-nine feet long, twenty-one feet broad and seventeen feet thick. It stretched out continuously in several directions, but has cracked in clefts on the uncovering of it. This effect has been attributed to the damp air of the mines, but it may, on the contrary, be in consequence of the evaporation of moisture contained in the mass under the action of the air.

A second malachite mass, which is a substratum to the first, exceeds it in extent and texture. Its structure is more variegated, or variously figured, than the first; and to obtain the pure mineral, the surface, consisting of loose spongy malachite, must be separated. It is in spots strowed with black and olive-green copper ore.*

In South America, according to Mr. Blake, green malachite occurs on the western coast of Bolivia, near Cobija, and at several places among the mountains to the southward of that place; also near Tanna, in Peru, and in the provinces of Copiapo and Coquimbo, in Chili.

Green carbonate of copper occurs beautifully crystallized at several of the copper mines of New Jersey, with massive red oxide of copper and the pure metal. At Greenfield, Mass., it forms a vein in trap rock on the west bank of the Connecticut river. It is associated with pyritous copper and sulphate of barytes. At Hamden and Cheshire, in Conn., it forms considerable veins in trap and sandstone, and at Bristol, Conn., in granite with variegated copper ore. It accompanies the preceding species, at the Perkiomen lead mine, is found also in the Blue Ridge, near Nicholson's Gap, and in very beautiful specimens, recently discovered, near Morgantown, Berks county, Penn. In Maryland, Virginia, and among the lead mines of Missouri, it is occasionally met with.

ANHYDROUS DICARBONATE OF COPPER.

Dr. Thomson, (*Outlines, &c.*, ii. 601.) Mysorite, *Beudant.*

Dr. Thomson obtained oxide of copper 60·75, peroxide of iron 19·50, carbonic acid 16·70, silica 2·10.

The peroxide of iron and silica traverse the mineral in small veins, showing them to be mere mixtures. Throwing these out, the atoms of oxide of copper, are just twice those of carbonic acid. The mineral is therefore a dicarbonate of copper without water. Formula: $\text{Cp}^2\dot{\text{C}}$.

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* Transactions of the Russian Imperial Mineralogical Society, 1842, p. 131.

Sp. Gr. 2·62. H. = 4·25.

Occurs massive, having an impalpable composition. When pure its color is brownish-black, but it is frequently tinged green and red from admixture with carbonate of copper and oxide of iron. Fracture small conchoidal. Is soluble in acids when pure, but if mixed with foreign matter the solution deposits a red precipitate. This rare substance was noticed by Dr. Heyne, near the eastern frontier of Mysore in Hindustan, where it is mentioned as forming beds in the older rocks.

CHRYSOCOLLA.*

Uncleavable Staphyline Malachite, M. Eisenschüssig Kupfergrün, W. Cuivre Carbonaté Terreux, H. Chrysocolle, Br. Copper Green, J. Kieskupher. Kieselmalachite. Silico-Carbonate of Copper, *Thomson*. Cypralus amorphus, D.

	Siberia.	Siberia.	Bogoslowsk.
Oxide of copper	50·0	49·63	40·00
Silica	26·0	26·37	36·54
Water	17·0	17·50	20·20
Carbonic acid	7·0	3·00	0·00
Sulphate of lime	0·0	1·50	0 00
Iron	0·0	0·00	1·00
	100·0 Klaproth.	100·00 John.	98·84 Kobell.

	Somerville, N. J.		Bogoslowsk.
Silica	35·4	25·31	35·0
Oxide of copper	35·1	54·16	39·9
Water	28·5	5·25	21·0
Carbonic acid	1·0	14·98	1·1
Oxide of iron	0·0	0·00	3·0
	100.0 Berthier.	100·00 Thomson.	100·0 Berthier.

It is not improbable from the great variations in these results, that the carbonate and silicate of copper are only mechanically mixed in this mineral. Dr. Thomson, from his own analysis, supposes its constitution to be thus: $Cp\dot{C}+\underset{\cdot}{C}pS^2Aq$.

Sp. Gr. 2·0 — 2·2. H. = 3.

Color emerald- and pistachio-green, passing into sky-blue; and inclining to brown when impure. It occurs botryoidal, stalactitic, reniform, massive, and investing other ores of copper; fracture earthy or conchoidal; translucent or opake; is shining or dull; it varies in hardness from almost friable to that of quartz. B B, on charcoal, it blackens in the exterior flame, and reddens in the reducing, but does not fuse; with borax it forms a green glassy globule, and is partly reduced. If pure, it is soluble with effervescence in nitric acid, and leaves a residue of silica.

This substance differs much in appearance; in the same

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* This word was applied by the ancients to several varieties of copper ore, and even to factitious substances. According to Pliny it was a substance used in soldering gold. — *Moore's Ancient Mineralogy.*

nen it sometimes bears at one end the character of an
decomposed felspar, passing by insensible degrees tow-
he other, into brittle translucent green chrysocolla.
s found in veins in primitive and secondary mountains,
ther ores of copper, as in Cornwall; very plentifully on
land of Cuba; at Jersey; at Falkenstein and Schwatz
Tyrol in limestone; in the Bannat, Hungary, Siberia,
lexico. It has been rarely found in the United States.

LICATE OF COPPER, of *Bowen*. — This is a variety of chrysocolla
he Somerville copper mine in New Jersey, analyzed by Mr. G. T.
, and first described in vol. iii. of the Journal of the Academy of Natu-
ences, Philadelphia. Its color is bluish-green; color of its powder
ue. It is massive and opake; its fracture is conchoidal and dull. It
le and is easily scratched by the knife. Its specific gravity is 2·159.
B B, it becomes black, but is infusible; with borax it fuses into a
f a bright green color, and when heated with subcarbonate of soda,
globules of metallic copper. When treated with nitric acid, it is
lissolved without effervescence, and affords a solution of a blue color.
led silica 37·250, peroxide of copper 45·075, water 17·000.

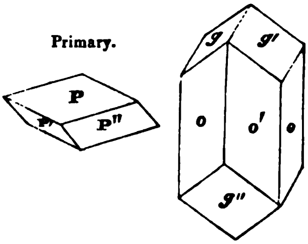
mineral forms an incrustation on the ferruginous copper of the
nd is accompanied by native copper, malachite, red oxide of copper,
tive silver. Berthier has more recently analyzed what appears to
same mineral, the results of which are given on the preceding page.

SILICATE OF COPPER.

DIOPTASE*.

hedral Emerald Malachite, M. Emerald Copper. Achirite.† Kupferschmaragd.
Cuivre Dioptase, H. Bt. Rhomboidal Emerald Malachite, J. Hydrous Sesqusili-
f Copper, *Thomson*. Cypralus rhombohedrus, D.

glass feebly; and is brittle. B B, in the matrass, yields water and blackens; on charcoal becomes black in the oxidating flame, and red in the reducing, but does not melt; it fuses however, with glass of borax, imparting to the globule a green tinge, and is ultimately reduced. Insoluble in nitric acid, even when heated, but is dissolved without effervescence in muriatic.



P on P′ or P″ primary	53° 43′
g on *g*′	95 33
o′ on *o* or *o*	120 4
g on *o*, or *g*′ on *o*′	133 0

It occurs in the Kirghese Steppes of Siberia, disposed on quartz or limestone, and always crystallized in well-defined elongated dodecahedrons, or in modifications thereof.

As the Achirite, above all minerals, resembles emerald in its rich green color, it has been known in France as the emerald of Siberia, and was called by Werner, copper emerald. The present Emperor of Russia, has presented a costly group of crystals of this rare variety, to the Imperial Mineralogical Society of St. Petersburg, consisting of uncommonly large and perfectly formed crystals surrounded by crystals of calc-spar.*

SULPHATE OF COPPER.

Blue Vitriol. Cyanose, *Beudant*. Tetarto-Prismatic Vitriol Salt, M. Prismatic Vitriol, J. Vitriol Bleu. Cuivre Sulfatè, H. Kupfer Vitriol, W. Vitriolum Cyprium, D.

It is a hydrous sulphate of copper of the same composition with the artificial salt, consisting of one atom sulphuric acid, one atom oxide of copper, five atoms water = oxide of copper 31·72, sulphuric acid 32·14, water 36·14. Formula: $\underset{\cdot}{C}p\dot{S}l+5Aq$.

Sp. Gr. 2·213. H. = 2·5.

Color deep sky-blue, sometimes passing into bluish-green. Occurs massive, stalactitic, and pulverulent; lustre vitreous; translucent; cleavage imperfect; fracture conchoidal; taste nauseous, and metallic. When artificially prepared, it crystallizes. It is readily soluble in water, and affords a blue solution, a polished surface of iron dipped into which becomes coated with a film of metallic copper. Primary form an Oblique rhombic prism; but as it seldom occurs in nature in distinct crystals, the following figure and measurements refer to the artificial crystals.

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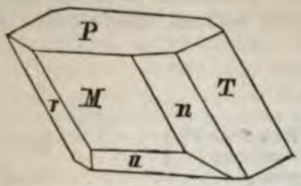
* Transactions of the Imperial Mineralogical Society of St. Petersburg, vol. i. part i. p. 130.



P on M	109° 32′
T on P	128 27
M on T	149 2

It owes its existence principally to the decomposition of copper pyrites, and is found dissolved in water issuing from mines, from which it deposits itself spontaneously. Its principal localities are the Rammelsberg mine near Goslar in the Hartz, Fahlun in Sweden, Neusohl in Hungary, Pary's mine in Anglesea, Cornwall, and Wicklow. Before being used in the arts it requires purification, and is then employed in printing cotton and linen, dyeing, &c.

Tetrasulphate of Copper.—A salt of this composition occurs in Mexico, and has been analyzed by Berthier, (*Memoirs*, ii. 191.) It contained oxide of copper 45·9, sulphuric acid 11·5, water 12·1, gangue 30·5. These numbers correspond with one atom sulphuric acid, four atoms oxide of copper, four and a half atoms water. Only a very imperfect description has been given of this mineral. Its gangue is granular quartz rock, which is penetrated with red oxide of copper in a lamellar state. It is of a verdigris green color, has no lustre, and an earthy aspect. Occurs in grains and small masses. Its precise locality is not known.

BROCHANTITE.*

Levy. (*Ann. of Phil., second series*, viii. 241.)

Combination of sulphuric acid, oxide of copper, and water.

Oxide of copper	62·63	66·93
Sulphuric acid	17·13	17·43
Water	11·89	11·91
Oxide of lead	8·18	1·04
Oxide of tin	0·03	3·14
	99·86 Magnus.	100·45 Magnus.

The formula, as given by Rammelsberg, is $\dot{C}p^3\dddot{S}l+3\dot{H}=$ 63 94 oxide of copper, 21·55 sulphuric acid, 14·51 water.

Sp. Gr. 3·78 — 3·87. H. = 3·5 — 4·0.

Primary form a Right rhombic prism M on M′ = 114° 20′.

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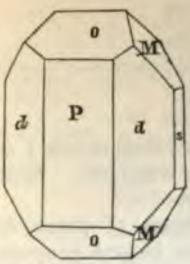
* In honor of Mons. Brochant, the well-known French mineralogist.



o on o contiguous	150° 30′
M on M over the terminal edge between o and o . .	114 20
d on d over P	117 0

Traces of cleavage parallel to M. Brochantite occurs in small well-defined transparent crystals of an emerald-green color, and having a vitreous lustre. The crystals from the last named locality, according to G. Rose, have a pearly lustre. Is soluble in acids, but does not dissolve in water. B B, in the matrass it yields water, exhaling the odor of sulphurous acid; on charcoal *per se* it is reduced into a non-malleable grain of copper; and with soda fuses into a metallic globule.

This mineral occurs associated with malachite and native copper at Ekatherineburg, and also near the Gumeschewstoika copper mine, in Siberia. It was described by Levy.

The *Königine* of Levy, (*Ann. of Phil.*, second series, xi. 194), or *Kœnigite* of Beudant, (*Traité*, ii. 487), is generally supposed to be nearly allied to Brochantite. Its primary form is a rhomboidal prism of about 105° and 75°. It cleaves with facility parallel to the base of the prism. Hardness between 2·0 and 3·0; color emerald- or blackish-green; transparent. It occurs at Werchoturi in Siberia. Specimens were found in the collection of the Dowager Countess of Aylesford.

BEAUMONTITE.*

Crenated Hydro-Silicate of Copper. *C. T. Jackson.*

This mineral was obtained from the old carbonate of copper mine of Chessy, France, in 1832. It was regarded as a hydrated silicate of copper, but subsequent analysis proved it to be a crenated hydro-silicate of copper. The analysis of a specimen which had effloresced by exposure to the air yielded to Dr. Jackson:

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* In honor of M. Elie de Beaumont; named and described by Dr. Jackson, anterior to M. Levy's description of Beaumontite (Heulandite). See Amer. Jour. of Science, for 1839, xxxvii. 398.

Silica	21·0
Deutoxide of copper	46·8
Crenic acid	15·8*
Water	10·0
Alumina and iron	4·4
Carbonic acid and loss	2·0
	100·0

It has the following characters. Forms stalactitical; color blue-green, when fresh, but greenish-white when dry. Specific gravity 1·88. Soft pulverulent when dry.

In the close tube gives off an abundance of water, when heated; the recent specimens giving the largest proportion. Heated to redness a portion of the copper is reduced, and the mineral in the tube is found to be a mixture of portions of copper with yellow and white powder. B B, on charcoal, it first decrepitates a little, then shrinks, leaving numerous cracks in it, and at last partially fuses and becomes yellow and white. On being levigated, yields particles of metallic copper. With soda, fuses giving a button of copper. With acids, it gelatinizes, and the solution is green and turns blue by excess of ammonia. When mixed with water, and sulphydric acid gas is passed through it, the copper separates as a sulphuret, and crenic acid and silica may be obtained by evaporating the solution to dryness. The crenic acid may be separated from the silica by a solution of carbonate of ammonia.

It occurs in stalactites on the roof of the mine, and is continually forming by infiltration through the porous sandstone rock. When recently obtained, it contains a much larger proportion of water, which it loses by exposure to dry air.

VELVET COPPER ORE.

Velvet Blue Copper, J. Kupfersammterz. Cuivre Velouté, *Levy.*

A compound of oxide of copper, sulphuric acid, silica, and zinc. — *Brooke.*

It consists of short delicate fibres of a smalt-blue color, frequently grouped in spherical globules, which are produced by the divergement of the capillary crystals from a centre. Translucent; lustre pearly. When dissolved in nitric acid, a skeleton remains, which is not soluble in any acid.

It occurs principally at Moldawa in the Bannat, coating the cavities of an earthy oxide of iron; but, from its extreme rarity, its characters have not been satisfactorily ascertained.

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* With a small portion of phosphoric acid.

CHLORIDE OF COPPER.

ATACAMITE.

Prismatoidal Habromene Malachite, M. Prismatic Atacamite, J. Salzkupfererz, W. Salzsaures Kupfer, L. Cuivre Muriaté, H. Bt. Muriate of Copper. Cypralus exhalans, D.

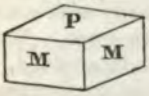
	Peru.	Chili.	Chili.	Crystals.
Oxide of copper	70·5	76·5	72·0	73·0
Muriatic acid	11·5	10·5	16·3	16·2
Water	18·0	12·5	11·7	10·8
	100·0 Proust.	99·5 Proust.	100·0 Klaproth.	100·0 J. Davy.

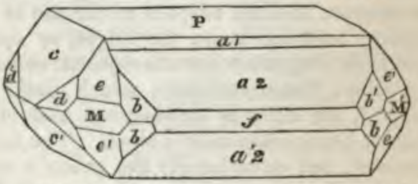
Formula, as given by Rammelsberg, from the two last analyses: $\mathrm{Cu}\overline{\mathrm{Cl}}+3\dot{\mathrm{Cu}}+3\overline{\mathrm{H}}$.

Sp. Gr. 4·0—4·3. H.=3·0—3·5.

Color various shades of green; by transmitted light, sometimes of an emerald-green. It occurs in minute crystals, of which the primary form is a Right rhombic prism of about 100° and 80° by the common goniometer, on the planes M M′ produced by cleavage,* which however have never been observed, although represented in the following figure, to show their position. In some of the crystals the planes *a*2, *a*2′, and *c*, *c*′, of the following figure, prevail to the exclusion of the rest, converting them into the octahedron with a rectangular base. The faces produced by cleavage parallel to the plane P, are very brilliant and easily obtained; those parallel to M and M′ are less so. It is translucent or nearly transparent, soft, and brittle. Streak apple-green; lustre vitreous. It tinges the flame of the blowpipe bright green and blue, muriatic acid arises in vapors, and a bead of copper remains on the charcoal. Is soluble without effervescence in nitric acid, and communicates instantaneously to ammonia a fine blue color.

Primary.





M on M	100° 00′?	*a*2 on *c*	110° 30′
P on *a*1	142 40	—— *e*	143 25
—— *a*2	123 25	*c* on *c*′	107 10
—— *c*	127 12	—— *d*	159 00
—— *e*	116 20	—— *e*	137 40
*a*2 on *a*′2	112 45	*e* on *e*	127 7

It is found at Remolinos in Chili on brown iron-stone, sometimes with ruby copper and carbonate of copper; in Peru with some of the ores of silver; and in the form of green sand in the river Lipas, in the Atacama desert (whence *Atacamite*), which separates Chili from Peru. Also, as noticed by Mr. Blake, in masses and small grains at Conchi, near the Andes, and at a point on the coast a few leagues south of Paposa in Bolivia. It also occurs in the iron mines of Schwartzenberg in Saxony; and on the lavas of Vesuvius, where it is probably formed by the union of muriatic acid and carbonate of copper, both of which are well known to be deposited by sublimation at that volcano.

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* According to Mohs and Beudant, the angles of this prism are 112° 45′ and 67° 15′.

HYDROUS DIPHOSPHATE OF COPPER.

LIBETHENITE.

Phosphorkupfererz, W. Cuivre Phosphaté, H. Br. Bt. Prismatic Olivinite, in part, J. Diprismatic Olive Malachite, M. Octaedrisches Phosphorsaurer Kupfer, *Leonhard.* Phosphorkupfer von Libethen, *Haidinger.* Libethenite, N. Aphérèse, *Beudant.* Cypralus dystomus, D.

Composed, according to Berthier, of

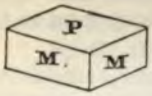
		Atoms.
Phosphoric acid	28·7	6·37
Oxide of copper	63·9	12·78
Water	7·4	6·57
	100·0	

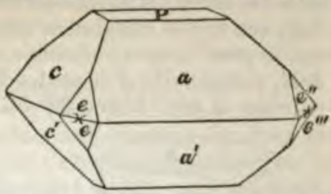
Its constitution is obviously one atom phosphoric acid, two atoms oxide of copper, and one atom water; or it is a hydrous diphosphate of copper. Formula: $\underset{.}{C}p^{2}+\dot{P}h+Aq$.

Sp. Gr. 3·6—3·8. H.=4.

It occurs crystallized, and in radiated masses; externally the crystals are greenish or blackish-green, approaching nearly to black, and are considerably splendent, but their surfaces are uneven, and not adapted to the use of the reflective goniometer; translucent on the edges, or opake; by transmitted light their fragments are olive-green, occasionally with a tinge of yellow; lustre resinous; streak dark olive-green. When radiated, the color is bluish-green and black intermixed, the exterior being often nearly black. The crystals are frequently prismatic, but occasionally the prism is so short as to reduce them to the general figure of an octahedron. They possess a distinct cleavage parallel to the plane P of the following figure; less perfect cleavages may also be obtained parallel to the edges *x x*, thus reducing the crystals to a Right rhombic prism of about 110° and 70°, which may be considered as the primary form. On charcoal it fuses into a brownish globule, which by the continued action of the blowpipe acquires a reddish-grey metallic lustre; in the centre is a small bead of metallic copper. With borax and salt of phosphorus it presents in the oxidating flame a green glass, which becomes in the reducing, colorless while hot, and of a cinnabar- or ruby-red when cold. Soluble without effervescence in nitric acid, to which, as well as ammonia, it imparts a sky-blue color.

Primary.





M on M or *x* on *x* . .	109° 30′ *c.g.*	*c* on *c*	121° 15′
P on *c*	126 10	—— *e*	149 10
a on *a*	95 15		

It is found in quartzose cavities associated with copper pyrites at Libethen, near Neusohl, in Hungary; also in small quantity in Cornwall, both crystallized and fibrous, in Gunnis Lake mine, on the banks of the Tamar.

It was formerly discovered at the Sommerville mine, in New Jersey, but is a very rare mineral in the United States.

HYDROUS PHOSPHATE OF COPPER.

RHENITE.

Prismatic Habroneme* Malachite, M. Pseudomalachit, *Hausmann.* Phosphorkupfer von Rheinbreitbach, *Haidinger.* Hydrous Phosphate of Copper, A. Ypoleime, *Beudant.* Prismatic Olivenite, or Phosphate of Copper, J. Rhenite. Hydrous Subbisesquiphosphate of Copper, *Thomson.* Cypralus hemihedrus, D.

Analyses by Arfvedson and the Rev. F. Lunn.

Phosphoric acid	24·70	21·687
Oxide of copper	68·20	62·847
Water	5·97	15·454
	98·87 Arfvedson.	99·988 Lunn.

The formula given by Beudant, from the relative quantities of oxygen in the constituents, is $\underset{\cdot}{C}p\dot{P}h+Aq=\dot{C}u^5\overset{\cdot\cdot}{\ddot{P}}+5Aq$. This is founded on the last analysis, and is the formula adopted by Rammelsberg to express the constitution of this species.

Sp. Gr. 4·2—4·3. H. = 5·0.

It occurs both massive and crystallized. The color of the massive approaches to emerald-green, striated with black or blackish-green; and it appears to consist of minute crystals often diverging or radiated. The more determinate crystals are generally dull and of a blackish-green color externally, sometimes black and splendent; by transmitted light they are emerald-green; translucent generally on the edges only, and possessing a vitreous or adamantine lustre. Streak a little paler than the color. By exposure to red heat in a close crucible, it becomes dark olive-green, and the powder increases considerably in bulk. B B, on charcoal, it fuses into a reddish-black slag, and by the addition of carbonate of soda is reduced to a bead of pure copper. Soluble without effervescence in nitric acid, particularly if heated. Primary form an Oblique rhombic prism of 141° 5′ and 38° 56′.

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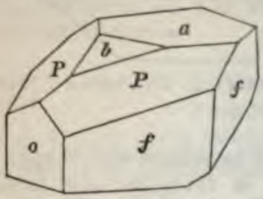
* From αβϱὸς, *delicate*, and νῆμα, the *thread*, or *fibre*.



P on P	117° 49′
f on f	141 4

The hydrous phosphate of copper is found at Rheinbreitbach, near Bonn, on the Rhine, in veins traversing grauwacke-slate, and accompanied by quartz and ores of copper. It generally presents itself either aggregated in extremely minute individuals, or mammillated and compact — its crystalline form therefore is not easily determined.

The Thrombolithe, from Retabanya in Hungary, analyzed by Plattner, (*J. f. pr. Ch.* xv. 321), consists of oxide of copper 39·2, phosphoric acid 41·0, water 16·8. These numbers correspond very nearly with one atom oxide of copper, three atoms phosphoric acid, two atoms water. It is therefore a hydrous terphosphate of copper. Formula: $\underset{\cdot}{C}p\dot{P}h^3+2Aq$.

OCTAHEDRAL ARSENIATE.

LIROCONITE.*

Prismatic Lirocone Malachite, M. Liroconite, *Beudant*. Linsenerz, W. Cuivre Arseniaté Primitif. H. Linsen Kupfer, *Haussmann*. Lenticular Copper Ore, J. Lenticular Arseniate of Copper, A. Cypralus rectangulus, D.

Combination of arsenic acid, oxide of copper, and water.

	Cornwall.	Cornwall.	Cornwall.
Oxide of copper	49·0	35·19	30·10
Arsenic acid	14·0	20·79	43·39
Water	35·0	22·24	26·69
Alumina	0·0	8·03	0·00
Oxide of iron	0·0	3·41	0·00
Phosphoric acid	0·0	3·61	0·00
Silica and gangue	0·0	6·99	0·00
	98·0 Chenevix.	100·26 Wachtmeister.	100·18 Thomson.

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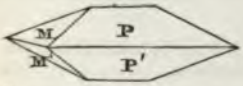
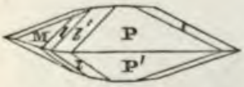
* The combinations of arsenic acid and oxide of copper, though not materially differing in their physical and blowpipe characters, form several distinct species, by peculiarities in their atomic constitution and crystalline forms. They have been named by Phillips according to the latter, and the same arrangement has been followed in this edition; prominence, however, being given to the most significant trivial title. [Am. Ed.]

These results are so discordant as to lead to the supposition that different minerals must have been employed. The second was obviously an impure specimen. Brooke, from his own analysis, has determined its constituents to be one atom arsenic acid, one atom oxide of copper, five atoms water; and excepting in a deficiency of water, Dr. Thomson's analysis gives the same result. Formula: $Cp\dot{A}s+5Aq$.

Sp. Gr. 2·88 — 2·92. H. = 2·0 — 2·5.

Color sky-blue, smalt-blue, and occasionally deep grass- or verdigris-green; translucent; cleavage imperfect parallel to all the planes of a flat octahedron; streak corresponding to the color, but paler; in the matrass it yields much water. B B, on charcoal, fuses imperfectly, emits arsenical fumes, and is converted into a black friable scoria; and by subsequent fusion with borax affords a bead of copper. Soluble without effervescence in nitric acid. The primary form is supposed to be an Obtuse octahedron, in which the common base of the two pyramids is rectangular; the octahedron being usually elongated as shown by the figures.*





P on P′	60° 40′
M on M′	72 22
P on l′	179 22
M on P or M′ on P	133 30
l on l	178 10

It occurs in veins passing through the adjoining mines of Huel Muttrell, Huel Gorland, and Huel Unity in Cornwall, associated with the following varieties; also with red oxide of copper, copper-pyrites, arseniate of iron, and the martial arseniate of copper. It is likewise met with at Herrengrund in Hungary in minute crystals.

RHOMBOIDAL ARSENIATE.

COPPER MICA.

Rhombohedral Euclore Mica, M. Hexahedral Arseniate, *Bournon.* Cuivre Arseniaté Lamelliforme, H. Prismatic Copper Mica, J. Kupferglimmer, W. and L. Cypromica, *Necker.* Cypralus foliaceus, D.

Combination of arsenic acid, oxide of copper, and water.

Oxide of Copper	39·0	58·0
Arsenic acid	43·0	21·0
Water	17·0=99·0 Vauquelin.	21·0=100·0 Chenevix.

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* It cleaves parallel to the planes of a Right rhombic prism, which is the primary form according to Brooke.

ie analysis by Chenevix, gives one atom arsenic acid, atoms oxide of copper, three atoms water. It is there- a terhydrous diarseniate of copper, and does not differ from Euchroite in its atomic constitution, though quite ict from it in other respects. Formula: $\text{Ç}p^{2}\dot{A}s+3Aq$.

Sp. Gr. 2·5 — 2·6. H. = 2·0.

lor emerald- or grass-green. In six-sided tabular crys- of which the lateral planes are trapeziums, inclining iately in contrary directions, being sections of an Acute boid of about 110° 30′ and 69° 30′; and it yields to age parallel to all the planes of the rhomboid, but with ct ease and brilliancy only at right angles to its axis, *i. e.* lel to the tabular planes *a*; these tables are often applied ch other laterally, forming rosettes, which may be sepa- into laminæ like mica. Streak rather paler than the . Lustre pearly parallel to *a*, vitreous parallel to P. sparent or translucent. B B, it decrepitates, emits arsen- fumes, and passes first into a spongy scoria, after which lts into a black slightly vitreous globule; with borax it ls a green glass, which includes grains of metallic copper. ble in nitric acid.

dotted lines in the first of the following figures exhibit the portion tabular crystal in the primary rhomboid.

OBLIQUE PRISMATIC ARSENIATE.

Diatomous Habroneme Malachite, M. Axotomous Habroneme Malachite, *Haidinger*. Radiated Acicular Olivenite, J. Strahlerz, A. Cuivre Arseniaté en Prisme Rhomboidal Oblique, *Levy*. Aphanèse, *Necker*. Cypralus acrotomus, D.

Combination of arsenic acid, oxide of copper, and water.

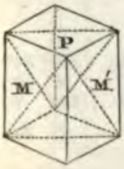
	Cornwall.		Atoms.
Oxide of copper	54·0	56·65	2·06
Arsenic acid	30·0	39·80	1·00
Water	16·0	3·55	0·57
	100·0 Chenevix.	100·00 Richardson.	

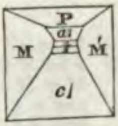
The constitution of this species, if we adopt the last analysis, is one atom arsenic acid, two atoms oxide of copper, one half atom water. If the water be viewed as accidental, it is nearly allied in composition with the next species, or an anhydrous diarseniate of copper — $\text{Çp}^2\dot{\text{A}}\text{s}$.

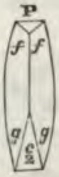
Sp. Gr. 4·1 — 4·28. H. = 2·5 — 3·0.

Externally bluish-black passing into deep black, with a shining lustre; internally greenish-blue. Occurs, though rarely, in extremely minute Oblique rhombic prisms, whose lateral planes meet alternately at angles of about 56° and 124°, and of which the oblique terminal plane declines from one acute angle to the other; they are frequently fasciculated in a somewhat radiating position, so that only the terminal planes of the following figures are distinctly visible; it also occurs in curved lamellar concretions. The minute crystals are often transparent and of a beautiful blue or greenish-blue color by transmitted light; the larger crystals are sometimes black and opake, but, on being scratched by the knife, appear internally of a blue color. Streak verdigris-green. B B, in the matrass yields water; on charcoal emits arsenical vapors, and fuses into a bead, which on cooling crystallizes in small rhombic plates of a brown color.

Primary.







M on M'	56°	0'
P on M or M'	95	0
—— a1	125	0
—— c1	80	30
—— c2	99	30
f on *f*	62	30

The dotted lines on the primary show that from the replacement of its acute angles arise the planes *c*1 of the second figure.

This species is only known in Cornwall, where it accompanies the preceding and other ores of malachite. The crystals present a very dark-blue color and brilliant lustre, but are rarely recognisable, being aggregated in diverging groups, or disposed in extremely minute individuals in the cavities of quartz.

RIGHT PRISMATIC ARSENIATE.

OLIVENITE.

Prismatic Olive Malachite, M. Cuivre Arseniaté Octaèdre Aigu, H. Acicular Olivenite, J. Acicular Arseniate of Copper, A. Olivenerz, W. Olivenkupfer, *Hausmann*. Olivenit, L. *Beudant*. Cypralus acicularis, D.

Combination of arsenic acid, and oxide of copper.

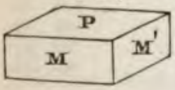
Oxide of copper	56·63	56·2
Arsenic acid	36·71	39·9
Water	3·50	3·9
Phosphoric acid	3·36	0·0
	100·20 Kobell.	100·00 Richardson.

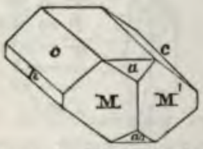
It is constituted of one atom arsenic acid, two atoms oxide of copper, and does not appear to be distinct from the last species. Formula: $\underset{,}{C}p^2\dot{A}s$.

Sp. Gr. 4·2—4·6. H.=3·0—3·5.

Color olive-green, pistachio-green, and blackish-green, passing into liver-brown and wood-brown; the fibrous variety siskin-green. Occurs in prismatic crystals, which are divisible parallel to the planes of a Right rhombic prism of about 110° 50′ and 69° 10′ (MM′). Streak olive-green or brown. Lustre between vitreous and resinous. Fracture conchoidal and uneven. Sometimes however the planes *c c* prevail to the exclusion of P, and the prism is then so short as to give it the general form of an octahedron with a rectangular base; the face *a* is extremely rare; the crystals are usually attached to the matrix at MM′. It also occurs capillary. B B, yields no water in the matrass; on charcoal emits an arsenical odor, fuses with a kind of deflagration, and is reduced, forming a white metallic globule, which during cooling becomes covered with a red coating. Is soluble in nitric acid, and colors ammonia blue.

Primary.





M on M′	110°	50′
P on M or M	90	00
M or M on *a*	132	7
c on *c* over P	92	30

This species occurs in Huel Gorland, and Huel Unity near St. Day; also in Tin Croft mine near Redruth, and elsewhere in Cornwall. It has also been observed at Alston Moor in Cumberland, but not in such splendid specimens as in Cornwall.

Capillary or Amiantiform Arseniate.—This variety presents the same colors, and occurs in minute crystals, occasionally exhibiting the planes *c*, *c* of the preceding figure; generally they are indeterminate, the capillary prisms being distinct for a part of their length, and terminated by extremely minute fibres of a greenish-white color and silky lustre.

Hæmatitic or Wood Arseniate.—Cuivre arseniate mamelonné fibreux, H. It occurs of various shades of brown, green, and yellow, often whitish or yellowish; and is found investing some of the preceding varieties, also mammillated; the structure is finely and divergingly fibrous, generally with a silky lustre. It sometimes possesses considerable hardness; frequently adheres to the fingers. B B, it yields a hard black cellular scoria. These varieties accompany the preceding species.

EUCHROITE.*

Haidinger. (*Edinb. Jour. of Science*, ii. 133.) Prismatic Emerald Malachite, M. Euchroite, *Breithaupt.*

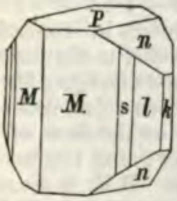
Combination of arsenic acid, oxide of copper, and water.

		Libethen.	Atoms.	
Contains	Oxide of copper	47·85	9·57	1·00
	Arsenic acid	33·02	4·55	2·10
	Water	18·80	16·71	3·67
		99·67 Turner.		

It is a hydrous diarseniate of copper, differing but slightly in its constitution from copper mica. Formula: $\underset{.}{C}p^2\dot{A}s+3\frac{2}{3}Aq$.

Sp. Gr. 3·38—3·41. H. = 3·5—4·0.

Primary form a right Rhombic prism of 117° 20′; cleavage indistinct; fracture uneven; color, bright emerald-green; transparent or translucent, with vitreous lustre, and considerable double refraction. Streak pale apple-green. In the matrass it yields water, changes its color, and becomes friable. When heated upon charcoal to a certain point, it is reduced in an instant with a kind of deflagration, leaving a globule of malleable copper, with white metallic particles disposed through it, which are crystallized on continuing the blast. It dissolves readily in nitric acid without effervescence.



n on *n* over P	87° 52′
M on M	117 20

This beautiful mineral occurs in crystals of considerable dimensions at Libethen in Hungary in quartzose mica-slate. It is very rare.

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* From Ευχϱοια (pulcher color).

CONDURRITE.

W. Phillips. Faraday. (Phil. Mag., new series, ii. 286.)

This name has been given by W. Phillips to an arsenical copper ore found at the Cordorrow mine, in the county of Cornwall.

Composition, according to Faraday, copper 60·50, sulphur 3·06, arsenic 1·51, arsenious acid 25·94, water 8·99. Dr. Thomson observes that there can be but little doubt that the arsenious acid originally existed in this ore in the state of metallic arsenic, and that it consisted of one atom sulphuret of copper, three atoms arseniet of copper.

Sp. Gr. 5·2045. H. not stated.

Color brownish-black; brittle; yields to the knife, which leaves a polished metallic looking surface, nearly of a lead-grey color. Occurs massive. When ignited it gives out a copious white vapor, leaving on the charcoal a metallic substance in a semi-fluid state of a yellow color.

KUPFERSCHAUM.

Prismatic Euclore Mica, M. Zinc Hydraté Cuprifère, *Levy.* Kupferschaum, W. Borodiglione. Kupaphrite. Cypralus decrepitans, D.

According to the analyses of Von Kobell, it is composed as follows:

Arsenic acid	25·01	25·366
Oxide of copper	43·88	43·660
Water	17·46	19·824
Carbonate of lime	13·65	11·150
	100·00	100·000

These numbers correspond with one atom arsenic acid, two and a half atoms oxide of copper, four and a half atoms water, forming the hydrous *sub-bisesquiarseniate* of copper, of Dr. Thomson. Formula: $\underset{.}{C}p^{2\frac{1}{2}}\dot{A}s+4\frac{1}{2}Aq$.

Sp. Gr. 3·0 — 3·2. H. = 1·0 — 1·5.

Primary form a Right rhombic prism. Occurs in rhomboidal plates, which present perfect cleavage parallel to the faces of the rhomb; generally in small aggregated and diverging fibrous groups of a pale apple-green or verdigris-green color, inclining to sky-blue, and translucent; lustre pearly on the faces of the rhomb; streak same as the color, but paler; thin laminæ are flexible. Entirely soluble in heated acids. B B, it decrepitates and fuses readily in the platina forceps into a blebby copper-red colored scoria; upon charcoal, it intumesces, disengages an alliaceous odor, and melts into a green scoria, containing numerous grains of metallic copper; with borax it readily forms a green limpid glass, and with soda is reduced.

Is found disposed in the cavities of calamine, associated with barytes, calc-spar, or quartz, in the Bannat, at Libethen in Hungary, Nerzschinsk in Siberia, Schwatz in the Tyrol, Saalfeld in Thuringia, and at Matlock in Derbyshire.

ERINITE.*

Dystomic Habroneme Malachite, M. Cypralus concentricus, D.

Oxide of copper 59.44, arsenic acid 33·78, alumina 1·77, water 5·01. — *Turner.* It differs from the preceding only in containing but one atom of water.

Sp. Gr. 4·0 — 4·1. H. = 4·5 — 5·0.

Form unknown; cleavage indistinct. In mammillated crystalline groups, consisting of concentric coats with rough surfaces, and exhibiting a fibrous structure. Color brilliant emerald-green, slightly inclining to grass-green; streak the same, but a little paler; lustre none; faintly translucent on the edges; fracture uneven, or imperfect conchoidal.

This species was distinguished by Haidinger; it occurs, though not abundantly, with arseniate of copper, in the county of Limerick.

VOLBORTHITE.†

Vanadiate of Copper.

This is a very rare mineral, and has been found only in Siberia, associated with other copper ores. The only account we have of it is a short one, which may be found in the *Transactions of the Imperial Mineralogical Society of St. Petersburg*, vol. i. 1842, p. 75. The exact locality is not stated; nor has the mineral been fully analyzed. It is described as occurring in small clusters of olive colored crystals, sometimes united into globular masses, but too imperfect to be determined crystallographically. Single splinters are transparent and reflect a glassy lustre. Scratches calcareous spar; specific gravity 3·55; streak bright green, almost yellow. The mineral was discovered accidentally in examining some Siberian copper ores, and Von Volborth observes, that he was surprised to find vanadic acid instead of phosphoric or arsenic acid, for which he was searching. The discovery is a very interesting one, as hitherto this acid has been found in nature only in combination with oxide of lead, in Mexico, Scotland, and East Russia.

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* Erinite, in reference to its locality, as well as to its characteristic emerald-green color.

† In honor of its discoverer, Von Volborth of Russia, named by Von Hess.

BLACK OXIDE OF COPPER.

chwarze, W. Copper Black, J. and A. Melaconise, *Beudant.* Cuivre Oxidé Noir.

is mineral is supposed to be a mixture of oxides of cop- d iron, and is not therefore an atomic combination.

or brownish-black, or black. Never occurs crystallized, massive, mostly disseminated in or investing other ores pper; commonly friable, soils the fingers, and is heavy. usible B B, into a black slag, yielding globules of cop- the reducing flame; and is acted upon by nitric acid, t the disengagement of gas.

ccurs in most of the Cornish mines, on the surface of ssociated with the botryoidal varieties of copper pyrites, rystallized and massive red oxide of copper and vitreous r, and may not improperly be considered as resulting he decomposition of these ores, which are frequently passing into black copper. It has likewise been ob- d at Chessy near Lyons, in Siberia, Peru, and many places, but only in small quantities.

as been found by Dr. Houghton among the copper ores mineral district of Michigan; and it occurs also among copper ores, at the lead mines of Missouri.

NATIVE GOLD.

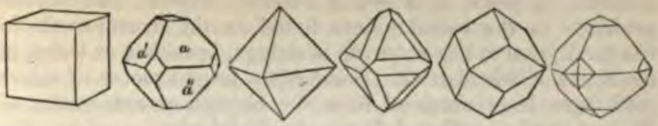
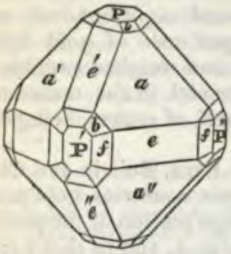

1. 2. 3. 4. 5. 6.

Fig. 1, the cube. Fig. 2, the same, of which the solid angles are replaced by planes; which are complete in fig. 3, forming the regular octahedron. Fig. 4, an octahedron, with its edges replaced by six-sided planes; which are complete in fig. 5, the rhombic dodecahedron. Fig. 6, an octahedron, whose solid angles are replaced by four triangular planes, forming on each an obtuse quadrangular pyramid.



P on P′ or P″.	90°	00′	H.
P, P′, or P″ on *a*	125	15	—
——— ——— *e*	135	00	—
a on *a*′ or *a*″	109	28	—
b on *b*	146	26	—
e on *e*′ or *e*″	120	00	—

It is found in veins or beds in primitive mountains, in nodules, plates, and small crystals, coating the cavities or interspersed through the mass. One crystal in the possession of W. Phillips, exhibited twenty-one varieties of form.

It occurs in granite in Salzburg, and at La Gardette in France; in gneiss and mica-slate in Mexico and the Tyrol; in hornblende rock at Edelfors in Sweden; and at Schlangenberg in Siberia. In Siberia it occurs in alluvium or sand, in the country eastward of the Ural Mountains, where masses of eight, ten, or sixteen pounds have occasionally been discovered. In Transylvania a considerable quantity of gold is obtained from stream works, as at Ohlapian near Hermanstadt. In the Wicklow mountains of Ireland, and at Leadhills in Scotland, it occurs in alluvial soil; and in many districts of Germany it appears under similar circumstances. The mines of Hungary and Transylvania, Cremnitz, Schemnitz, Posing, Botza, Magurka, Nagyag, Offenbanya, and Boitza, are all worked for this metal, and occasionally afford the most splendid specimens; and in Saltzburg, and thence along the chain of the Alps as far as La Gardette near Allemont in France, there are numerous other establishments of a similar description. — *Allan's Manual.*

In England, native gold has recently been obtained, in one instance, in veins, near North Tawton, Devon., and there is evidence in the rolled pieces found in tin stream-works in Cornwall, that it has occurred in strings, branches or lodes, in the rocks of this district. Some of the largest pieces of native gold have been obtained from the Cavnon stream-works.—*Report on Cornwall and Devon, by Delabeche.*

Humboldt has made known to the French Academy of Sciences, the discovery of a mass of native gold on the eastern side of the Ural mountains, weighing about eighty English pounds (thirty-six kilogrammes). The total product of the Russian mines in 1842, amounted to about sixteen thousand kilogrammes, of which seven thousand eight hundred were from the Siberian mines. The largest mass of gold before found, was from the same country, and weighed twenty-two English pounds; of this there is a model in the museum of Natural History in Paris, the mass itself, of course, being consumed in the arts.*

It is abundantly disseminated in Peru, Bolivia and Chili, among the Andes; and in all of these countries gold mines have been extensively worked. A large portion of the precipitous and broken ground of Chili affords it, and in that part of the country where it rains, a large number of the inhabitants find employment in searching for it in the sand washed down from the mountains, and along the various water courses. The most important mines in Chili, according to Mr. Blake, are those of Copiapo, Huasco, Coquimbo, Putaendo, Caen, Albue, Chibato and Quillota. At Petorca, in the province of Quillota, the mines are very extensive and rich. In Bolivia, at Potosi; in the districts of Chichay Tarija, Oruzo, Chayantas, and Caranjas. At Couchi it occurs associated with iron pyrites, in veins of quartz in feldspar porphyry. In Peru, in the district of Caxamarca, in the towns of Caxamarquilla and Huamachuco, a large quantity of gold has been obtained from washing the sand. In the province of Laricaxes, north of La Paz, in the mountain of San Chuli, is one of the richest veins which have been discovered It was worked for about fifty years, when the miners struck a spring of water so powerful as to oblige them to abandon the mines.

Native gold has been found in several of the United States, as in North and South Carolina, Virginia, Tennessee, Georgia, and Alabama, but there are but few mines systematically explored. The metal is usually found in small masses loose in the soil, or in the washed gravel of rivers. Lumps weighing several ounces are not uncommon, while those weighing several pounds have been met with; and one splendid mass has been discovered in Cabarras county, N. C., which weighed in its crude state twenty-eight pounds. When found, in place, the matrix is usually a white cavernous quartz, or a hydrated oxide of iron, in which the gold is frequently disseminated in particles too minute to be observed by the naked eye. Very recently, Dr. Jackson has discovered a brown auriferous pyrites at Grafton and Canaan, N. H., containing minute particles and laminæ of this metal, which possess great brilliancy.

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* Jameson's Edin. Phil. Journ., 1843, xxxiv. 387.

This hydrated peroxide of iron appears to have been derived from the decomposition of auriferous pyrites. "At the Whitehall mine, in North Carolina, gold of the value of $10,000 was found in the course of five days, in a space of about twenty square feet; and $7,000 value of gold was found at Tinder's mine, in Louisa county, in the course of one week."[*]

Gold is frequently combined with other metalliferous minerals, in various proportions; particularly native tellurium, and occasionally iron pyrites, which thence are termed auriferous.

The specular micaceous iron ore from Cocois, Brazil, contains compressed laminæ of native gold, which at first sight might be mistaken for mica or iron pyrites. The gold of Brazil is frequently associated with palladium, particularly that from Congo Socco.

ARGENTIFEROUS GOLD. ELECTRUM. Is distinguished by its silver-white color, although, as all gold contains a proportion of silver, no definite separation can be made between this variety and the above. The electrum which Klaproth analyzed, consisted of gold 64, silver 36. Another specimen, by G. Rose, gave of gold 74·41, silver 23·12. Specific gravity 14·0—17·0. B B, it fuses into a more or less pale-yellow globule. It occurs at Schlangenberg in Siberia in tabular crystals and imperfect cubes; also at Kongsberg in Norway; in Transylvania; and in other mining districts.

Beudant considers that not less than 88,100 marks of gold are annually produced from the different quarters of the globe, of which South America alone supplies 70,000, Africa 7000, Siberia 3000, Hungary and Transylvania 5100, &c. Its uses are well known; it is the most ductile and flexible of all metals, and is at the same time very soft. The electric shock converts it into a purple oxide. Its color when melted is bluish-green, the same as is exhibited by light transmitted through gold leaf.

NATIVE PLATINUM.[†]

Gediegen Platine, W. Platine Natif Ferrifère, H. Hexahedral Platina, M. and J. Platinum cubicum, D.

Is never met with pure, being alloyed with about 20 per cent. of other substances, particularly iron; also rhodium, iridium, osmium, and palladium,—four metals which were unknown till discovered in platinum. Berzelius has carefully examined native platinum, and three of his analyses are here given. It appears from these, that native platinum, like native gold, varies much in the proportions of its alloy, and is probably never entirely free from admixture with other metals. The various specimens contain from 74 to 87 per cent. of platinum, and from 6 to 13 per cent. of iron.

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[*] See an interesting paper, by Prof. Silliman, on the gold mines of Virginia, Am. Jour. of Science, xxxii. 98; and another by Prof. Olmsted, on those of North Carolina, Ibid., ix. 5.

[†] From a Spanish word signifying *silver*; in allusion doubtless to the color of platina.

	Ural. *Large grains.*	Columbia. *Small grains.*	Ural.
Platinum	78·94	84·30	73·58
Rhodium	0·86	3·46	1·15
Palladium	0·28	1·06	0·30
Iridium	4·97	1·46	2·35
Osmium	1·96	1·03	0·00
Iron	11·04	5·31	12·98
Copper	0·70	0·74	2·30*
	98·75 Berzelius.	98·08 Berzelius.	97·86 Berzelius.

Sp. Gr. 16·0—20·0.† H. = 4·0—4·5.

Color perfect steel-grey. Primary form the Cube. Occurs in irregular masses or grains, rarely exhibiting traces of crystallization; cleavage none; lustre metallic; streak unchanged and shining; ductile, and malleable. It requires a much higher degree of heat than can be produced by the common blowpipe, to cause fusion; but at the oxy-hydrogen flame it melts like lead. It slightly affects the magnet, in proportion to the amount of iron which it contains; and is soluble only in nitro-muriatic acid.

The original repositories of native platina are not generally known, it having been met with mostly in pebbles mixed with sand and other alluvial depositions, and sometimes with zircon and other gems. But M. Boussingault has discovered it in a sienite rock in South America, where it occurs in veins associated with native gold. It has principally been obtained from the provinces of Choco and Barbacoas in South America; also from Matto-Grosso in Brazil; St. Domingo, and Siberia. Is found in Peru, in the province of Quito; and in the districts of Novita and Citaza in the province of Choco, mixed with gold, titanium and magnetic iron sand. Latterly platina has occurred in such abundance at Joetsk, in the Perm government of Siberia, that the Russians have converted it into a medium of exchange, by coining it into ducats of ten roubles. In 1827, a remarkable specimen was found in the Ural, not far from the Demidoff mines, which weighed nine and a half pounds, avoirdupois; and at about the same time another was met with which weighed *twenty-seven pounds.* This is in the cabinet of the mining corps of St. Petersburg; and it much exceeds any mass hitherto found in South America.[*] Von Demidoff has sent several other large masses to St. Petersburg, weighing from ten to twenty pounds. From the discovery of this metal in 1825 to 1840, fifty-three thousand three hundred and thirty-six pounds twelve solotnic, were obtained from the Demidoff deposits. It is mostly obtained by washings from sand. Very rarely, it has been found in small grains disseminated through serpentine, and intermixed with octahedral crystals of chromate of iron. As a large portion of the sand through which the platinum is scattered is green, and has the appearance of disintegrated serpentine, it is supposed that this rock may have been the original repository of the metal. Serpentine is one of the principal rocks in the region of the rich deposits of Nische-Tagilsk, and gold has also been found in it. There occurs at the same place a conglomerate, consisting of serpentine and amphibole, united by an argilo-calcareous cement, in which both metals have been found in imbedded masses.[†]

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* Undissolved matter. The second specimen also contained 0·72 per cent. of earthy matters.

† The specific gravity of absolutely pure platinum is 21·5.

There is deposited in the Madrid museum a mass measuring two inches and four lines in diameter, and weighing eleven thousand six hundred and forty-one grains. The refractory properties of this metal, its freedom from rust or tarnish, and its not being acted upon by most chemical re-agents, render it extremely valuable in the construction of philosophical and chemical apparatus. It is used also for covering other metals, for painting on porcelain, &c. The common occurrence of gold as an inseparable concomitant of platinum, both in South America and in Siberia, leads us to hope that the latter metal may be discovered in the United States. In fact, Mr. Featherstonaugh states, in his Geological report, that he has in his possession a specimen from North Carolina.

NATIVE PALLADIUM.[‡]

Wollaston. (*Phil. Trans.* 1809, p. 189.) Palladium, J. Octahedral Palladium, *Haidinger.* Palladium octahedrum, D.

It consists of palladium, alloyed by minute portions of platina and iridium. Symbol, Pal.

Sp. Gr. 11·5 — 12·5. H. above 4·5.

Primary form the Octahedron. Occurs in grains apparently composed of diverging fibres; in other respects these grains differ little in external character from those of platina, amongst which they are found. Cleavage none; lustre metallic; color steel-grey; ductile, and very malleable. Yields a red solution with nitric acid; and is soluble in muriatic, but not in sulphuric acid, unless heated. B B, *per se*, it is infusible, but on the addition of sulphur it melts with ease; and when the heat is continued the sulphur is deposited, and a globule of malleable palladium remains. Isolated and rubbed, it acquires resinous electricity.

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[*] Dickson, on the gold, silver, and platina of Russia. Featherstonaugh's Journal, No. 3, September, 1831.

[†] Transactions of the Russian Imperial Mineralogical Society, 1842, pp. 133, *et seq.*

[‡] Palladium; from the planet Pallas.

It is found intermixed with native platina in Brazil and Siberia; and, except that its texture appears more fibrous, it bears much resemblance to that substance. At the mine Congo Soco, in Brazil, it is mixed with gold, and contained in an ochrey variety of hydrated peroxide of iron.

SELENIET OF PALLADIUM.

Zinken. (*Ann. de Chim. et de Phys.* lxiv. 206.)

This mineral was found with seleniet of lead at Tilkerode, in the Duchy of Anhalt-Bernborg, in the Hartz. M. Zinken obtained it while examining the seleniet of lead, in order to obtain the gold and silver with which it was mixed.

He found that it existed mixed with native gold in the form of small platinum white plates, crystallized in six-sided tables. These plates have a foliated structure, and cleave in a direction parallel to the axis of a six-sided prism. When heated strongly it becomes colored, and it is more brittle than any noble metal in a state of purity. When heated in a tube it gives out selenium. With borax it forms a transparent glass, and gives a brittle metallic globule which, when cupellated with lead, does not change its nature. By examining it by solution in acids, M. Zinken showed that it is a compound of selenium, palladium, silver and lead. Hence it is probably a triple seleniet of palladium, silver and lead, in proportions not yet determined.

PURE NATIVE IRIDIUM.

Breithaupt.

Sp. Gr. 23·55. In minute grains, occasionally accompanying platinum, at Nische-Tagilsk in Siberia.

Native iridium with specific gravity, 23·646, as given by Breithaupt, was found by Rose to be 22·65. It is therefore *heavier than platinum, and the heaviest of all known bodies.*

ALLOY OF IRIDIUM[*] AND OSMIUM.

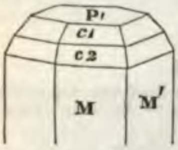
Wollaston. **Iridium, J. Iridosmine, *Necker.* Rhombohedral Iridium, M. Iridium Osmié, H. Iridium hexagonum, D.**

Berzelius maintains that there are three different combinations of iridium and osmium, in which one atom of the former is united with one, three, and four atoms of the latter.

Iridium	72·9	46·77
Osmium	24·5	49·34
Rhodium	0·0	3·15
Iron	2·6	0·74
	100·0 Thomson.	100·00 Berzelius.

Sp. Gr. 18·25 — 19·5. H. above 4·5.

Primary form a Hexagonal prism. This natural alloy is rarely found crystallized; generally in small, irregular, and flattened grains, which have a shining metallic lustre, but are of a somewhat paler steel-grey color than native platina, and are harder and heavier; they possess a lamellar structure parallel to the terminal planes of the crystals, and are brittle. Is not soluble in nitro-muriatic or any other acid; and is infusible B B, both alone and with fluxes. Fused with nitre, it emits a peculiar chlorine-like odor, and becomes black; but recovers its original color and lustre by heating on charcoal.



P on M or M′	90°	0′	Bournon.
M on M′	120	0	
P on *e*1	124	42	
— — *e*2	114	57	

It occurs along with platina, in the province of Choco in South America, and in the Ural Mountains of Siberia.

NATIVE TELLURIUM.[†]

Hexahedral Tellurium, J. Gediegen Sylvan, W. Gediegen Tellur, *Hausmann.* Tellure Natif Auro Ferrifère, H. Tellurium hexagonum, D.

Consists, according to Klaproth, of tellurium 92·55, iron 7·20, gold 0·25; or eleven atoms tellurium, one atom iron. But it is probable that the iron is only mechanically mixed, so that native tellurium may really be regarded as the pure metal. Symbol: Tl.

Sp. Gr. 6·1 — 6·2. H. = 2·0 — 2·5.

Color tin-white, passing into lead-grey; with a shining metallic lustre. Primary form, a Rhomboid; secondary, an hexagonal prism, with the terminal edges replaced by single planes; cleavage parallel to the faces of the primary, but, from the minuteness of the crystal, indistinct. Easily frangible.

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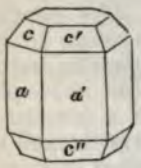
[*] Iridium; Iris, a rainbow; its solutions are variegated.

[†] From the Latin, Tellus, the earth.

It also occurs in crystalline grains, either aggregated, solitary, or disseminated; yields to the knife, and is brittle. Exposed to the blowpipe, it melts readily, burns with a greenish flame, and is almost entirely volatilized in a dense white vapor; it at the same time emits a pungent odor like that of horse-radish, which, however, is derived from a minute proportion of selenium in combination. Is soluble in muriatic acid.



a on a'	120° 00′
a' on c' or c''	147 36

It has only been found in the mine of Maria Loretto, at Facebay near Zalathna in Transylvania, where it occurs in veins, in sandstone, with iron pyrites and quartz. It is a scarce mineral.

GRAPHIC TELLURIUM.

Graphic Gold. Schrifterz, W. Aurum graphicum. Tellure Natif Auro-Argentifère, H. Silvanite, *Necker*. Sylvane Graphique, *Brochant*. Prismatic Antimony Glance, M. and J. Lunites Auricus, D.

Union of tellurium, gold, and silver.

Tellurium	60·0	52·0
Gold	30·0	24·0
Silver	10·0	11·3
Lead	0·0	1·5
	100·0 Klaproth.	88·8 Berzelius.*

The formula given by Berzelius, and founded on the first analysis, is $AgTl+3AuTl^3$.

Sp. Gr. 5·7. H. $=1{\cdot}5-2{\cdot}0$.

Of a steel-grey color, approaching to tin-white, and is generally splendent, but sometimes slightly tarnished externally. Primary a Right rhombic prism; the crystals are commonly modified on the edges and angles, are extremely indistinct, and generally minute. Cleavage perfect parallel to M; fracture uneven; yields easily to the knife, and is brittle. B B, it fuses into a dark-grey metallic globule, covers the charcoal with white fumes, which at the reducing flame disappear, and, after a continued blast, is converted into a brilliant and malleable bead. Soluble in nitric acid.

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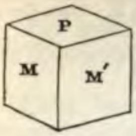
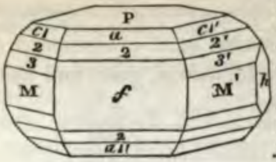
* The deficiency to make up the 100 parts being iron, copper, antimony, sulphur and arsenic; but owing to the small quantity of the mineral employed, Berzelius considers his analysis imperfect.





P on M or *f* . .	90°	00′
M on M′	107	44
P on *a*1	141	30
—— *a*2	129	12
—— *c*1 or *c*1′ .	151	40
—— *c*2 — *c*2′ .	136	42
—— *c*3 — *c*3′ .	132	45
M on *h*	126	8
f on *h*	90	0

The German name of *shrifterz* was applied to this species by Werner, in allusion to the peculiar disposition of its crystals, which are frequently arranged in rows more or less resembling graphic delineations. Several different crystalline forms have been noticed, but the individuals being small, and in this manner disseminated and engaged, they have not yet been satisfactorily described. It occurs accompanying gold in narrow veins, which traverse porphyry, at Offenbanya in Transylvania; also at Nagyag in the same country. Its large proportion of gold renders this a highly valuable ore. — *Allan's Manual.*

HERRERITE.

Herrerite, *Del Rio.* *Shepard.* Niccalus Herreri, D.

Contains, according to Herrera, carbonic acid 31·86, tellurium 55·58, peroxide of nickel 12·32; but is probably a mixture, rather than an atomic combination.

Sp. Gr. 4·3. H. = 4·0 — 4·5.

Occurs in reniform masses. Cleavage in three directions, affording rhomboidal fragments, whose angles are incapable of measurement on account of the curvatures of the faces. Lustre vitreous to pearly, and shining on fresh surfaces. Color pistachio-, emerald-, and grass-green. Streak yellowish-grey. Translucent. Brittle. B B, on charcoal it at first becomes grey, and afterwards emits a white smoke, which adheres to the charcoal; in the reducing flame it becomes of a beautiful grass-green. Heated in an open tube, it gives off abundant white fumes, which adhere to the glass; and on examining these with a microscope they appear to consist of numerous white transparent globules.

It occurs at Albarradon in Mexico, traversing transition limestone in a metallic vein, consisting chiefly of ores of lead, silver, muriate of silver, and iodic silver. When decomposed it appears earthy and dull, with a somewhat fibrous structure.[*]

YELLOW TELLURIUM.

Weiss Sylvanerz, W. Weiss Tullur. Gelberz, L. Mullerine, *Necker*. Yellow Gold Glance, or Yellow Tellurium, J. Tellure Aurifère and Plombifère, H. White Ore of Tellurium. Aurum rhombicum, D.

Union of tellurium, gold, and lead.

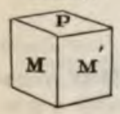
Tellurium	44·75
Gold	26·75
Lead	19·50
Silver	8·50
Sulphur	0·50
	100·00 Klaproth.

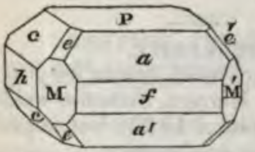
Formula by Berzelius: $AgTl+2PbTl+3Au^{2}Tl^{3}$.

Sp. Gr. 8·9 — 10·67. Soft.

Silver-white, passing into brass yellow. Primary a Right rhombic prism of 105° 30′, and 74° 30′. Occurs in small but well-defined crystals; possesses a bright metallic lustre; and is somewhat sectile. B B, it covers the charcoal with oxide of lead, melts into a white metallic globule, and emits a pungent odor. Soluble in nitric acid, leaving a yellow metallic residue.

Primary.





M on M	105°	30′
P on M or *f*	90	00
M on *f*	142	30
—— *h*	127	30
a on *f*	161	30
c on *h*	126	55
—— *a*	123	30

The above measurements are by Brooke.

This very rare mineral occurs at Nagyag in Transylvania, in irregular veins in porphyry with gold, native arsenic, sulphuret of manganese, and black tellurium; also in the Altai Mountains, Siberia.

BLACK TELLURIUM.

Nagyagererz, W. Blättererz. Tellure Natif Auro-Plombifère, H. Prismatic Black Tellurium, J. Bitelluret of Lead, *Thomson*. Pyramidal Tellurium Glance, M. Blattertellur, *Hausmann*. Foliated Tellurium, A. Telluro Galène, *Necker*. Elasmose, *Beudant*. Elasmites quadratus, D.

Combination of tellurium, lead, gold, and sulphur.

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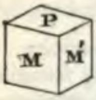
[*] Shepard's Mineralogy, i. 257.

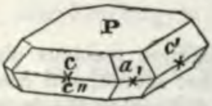
	Nagyag.	Nagyag.	Nagyag.	Altai.
Tellurium	32·2	31·96	13·0	38·37
Lead	54·0	55·49	63·1	60·85
Gold	9·0	8·44	6·7	0·00
Silver	0·5	0·00	0·0	1·28
Copper	1·3	1·04	1·0	0·00
Sulphur	3·5	3·07	11·7	0·00
Antimony	0·0	0·00	4·5	0·00
	100·0 Klaproth.	100·00 Brandes.	100·0 Berthier.	100·50 G. Rose.

The atomic constitution from Berthier's analysis, as given by Rammelsberg, is $SbSl^3+2AuTl^3+18PbSl$

Sp. Gr. 7·0—7·2. H.=1·0—1·5.

Color between iron-black and dark lead-grey; is found crystallized in small and nearly tabular crystals, of which the primary form is a Right square prism; cleavage perfect parallel with P; lustre metallic; yields easily to the knife, is sectile, and in thin laminæ highly flexible, though not elastic. On paper it leaves slightly black traces; and, when isolated and rubbed, acquires resinous electricity. B B, it melts emitting a dense vapor, which partly concretes on the charcoal in the form of reddish-brown powder; and yields a malleable metallic globule. With borax it affords a bead of gold containing a little silver; and in nitro-muriatic acid is soluble without much difficulty, leaving a white residue.





M on M or *x* on *x* .	90° 00'	*c.g.*
x' on *x* or *x*	135 00	—
P on *a*	118 35	
P on *c* or *c'*	110 00	*c.g.*

Occurs in foliated masses and crystalline plates, associated with gold, blende, and red manganese, at Nagyag in Transylvania, and accompanying antimony ores at Offenbanya in the same country. Also at Altai.

The mineral analyzed as above by Berthier, Dr. Thomson regards as a distinct species, and has so described it, under the name of *Nagyag tellurium ore.* The common black tellurium he regards as a bitelluret of lead, the constituents besides tellurium and lead, being accidental. This view of its composition is rendered more probable, by the analysis of a purer specimen by Prof. G. Rose, from Altai, which gave almost exactly two At. tellurium to one At. lead. Dr. Thomson has therefore very properly placed black tellurium among the species of lead. (See Bitelluret of Lead.)

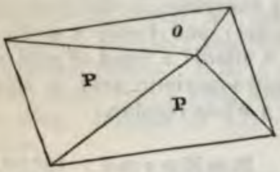
NATIVE ANTIMONY.

Gediegen Spiesglas, W. Antimoine Natif, H. Br. Bt. Dodecahedral Antimony, J. Rhombohedral Antimony, M. Stibium rhombohedrum, D.

Contains about ninety-eight per cent. of antimony, with minute proportions of silver, iron, arsenic, &c., which are accidental. Symbol: St, or Sb.

Sp. Gr. 6·5 — 6·8. H. = 3·0 — 3·5.

Of a tin-white color, but by exposure becomes tarnished yellow. In nature it occurs reniform and amorphous, and in distinctly lamellar concretions, but has not been observed crystallized. The crystals, however, produced by fusion are readily recognised, and, being the identical substance, may be assumed as the same. The primary form of these is an Obtuse rhomboid of 117° 15′ and 62° 45′. It possesses a highly perfect cleavage, with a splendent metallic lustre, parallel to *o*, and another, though with a minor degree of lustre, parallel to P.



P on P . . . . 117° 15′

Isolated and rubbed, it acquires resinous electricity. It yields to the knife, is somewhat sectile, and easily frangible. B B, it fuses readily, and, by continuing the heat, may be entirely volatilized in the form of a grey vapor; but if the fused mass be allowed to cool slowly, it becomes covered with brilliant white acicular crystals. When alloyed with a small proportion of arsenic, the vapor has the odor of garlic. Is soluble in nitric acid, leaving a whitish deposit.

It occurs in veins traversing gneiss, in Dauphiné, with the ores of antimony and cobalt; at Andreasberg in the Hartz; at Allemont near Grenoble in France; at Sahlberg in Sweden, in reniform masses disseminated in calcareous spar; also in Mexico. An arsenical variety is found at Allemont. It is frequently associated with antimonial silver, from which it may be distinguished by its comportment B B; and is generally accompanied by antimonial-ochre, which appears to be produced by its decomposition. From its property of hardening the softer metals, antimony is employed as an alloy, particularly with lead and tin; and in several pharmaceutical preparations.

BERTHIERITE[*]

Berthierite, *Haidinger.* Haidingerite, *Berthier.* Lycites Berthieri, D.

		Bräunsdorf.	Auvergne.
Contains	Antimony	54·700	52·0
	Sulphur	31·326	30·3
	Iron	11·432	16·0
	Zinc	0·987	0·3
	Manganese	2·544	0·0
		100·739 Berthier.	98·6 Berthier.

Formula by Rammelsberg answering to the first analysis: $2\overset{\prime\prime\prime}{\mathrm{Sb}}+3\overset{\prime}{\mathrm{Fe}}$.

Does not occur crystallized, but is found in masses confusedly lamellar, or composed of indistinct elongated prisms; cleavage parallel to the axis of the prism; color dark steel-grey, inclining to pinchbeck-brown; lustre metallic. It fuses readily B B, emits vapors of antimony, and forms a black slag which acts on the magnet. With fluxes it presents the indications of iron. It is soluble quickly in muriatic acid, with disengagement of sulphuretted hydrogen.

This species is found at Chazelles in Auvergne, associated with quartz, calcareous spar, and iron pyrites: when fused it yields antimony of such inferior quality that it is useless as an ore. It occurs also in the department of Creuse, and at Bräunsdorf, near Freyberg, in Saxony.

SULPHURET OF ANTIMONY.

Prismatoidal Antimony Glance, M. Grey Antimony, J. Antimoine Gris, *Brochant.* Stilbine, *Beudant.* Grau Spiesglaserz, W. Antimoine Sulfuré, H. Sesquisulphid of Antimony, *Thomson.* Lycites diatomus, D.

Combination of sulphur and antimony.

Antimony	73·77	75·0	74·0
Sulphur	26·23	25 0	26·0
	100·00 Thomson.	100·0 Proust.	100·0 Bergmann.

These numbers correspond very nearly with one atom antimony, and one and a half atom sulphur. Formula: $\mathrm{StSl}^{1\frac{1}{2}}$.

Sp. Gr. 4·3 — 4·6. H. = 2·0.

The massive presents a long columnar composition; and the fibrous variety occasionally exhibits a plumose, woolly, or felt-like appearance: this last is the *federerz* of German mineralogists — the antimoine sulfuré capillaire of Haüy. Color light lead-grey, sometimes dull externally, often iridescent. Primary form a Right rhombic prism, of about 88° 30′ and 91° 30′. It occurs massive, disseminated, and crystallized in bic prisms, variously modified and terminated; the cr re sometimes closely aggregated laterally; it yields re cleavage at right angles to the plane *h* of the followi , with brilliant surfaces. Brittle; yielding to the pr of the nail; soils paper black when rubbed on it; a on friction a sulphurous odor. In the flame of a can lts, even when in considerable masses; B B, it is absorb e charcoal, and gives off at the same time a sulphur and white fumes.

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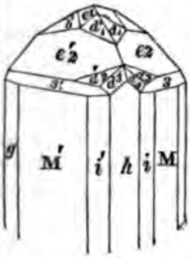
[*] Named by Haidinger in compliment to its discoverer, Professor Berthier of Paris.



M′ on M	88°	40′
M′ on *e*′2 or M on *e*2 . .	145	30
M′ or M on *h*	134	20
M′ on *i*′ or M on *i*	171	40
M′ on *g*	173	00
e′2 on *e*2	108	30
h on *e*′2 or *e*2	125	30
—— *i*′ or *i*	161	30

occurs principally in veins, which in some places, as sthal in Hungary, are almost entirely composed of gr ony. Felsobanya, Schemnitz, and Cremnitz in Hu are, however, the most celebrated localities of t es; being frequently found in these mines in distin ging prisms several inches in length, associated with a

The *federerz* of the Germans, or *feather ore lead*, also called *plumose antimonial ore*, differs but little from the above, and may be here introduced as a variety. It is formed of long flexible crystals, hair-like, and occupying the drussy cavities of quartz; sometimes resembling a cobweb. Opake, soft and sectile. Crystalline form not determined. It contains, by the analysis of H. Rose, a little more sulphuret of lead than Jamesonite. Occurs at Wolfsberg in the eastern Hartz, and at Freyberg and Braunsdorf in Saxony.

JAMESONITE.*

Axotomous Antimony Glance, M. Jamesonite, *Haidinger*. Lycites acrotomous, D.

This mineral has been analyzed by Prof. H. Rose, and by Count Schaffgotsch.†

	Cornwall.	Cornwall.	Estremadura.
Sulphur	22·15	22·53	21·785
Lead	40·75	38·71	39·971
Antimony	34·40	34·90	32·616
Iron	2·30	2·65	3·627
Copper	0·13	0·19	0·000
Bismuth	0·00	0·00	1·055
Lead, iron and zinc	0·00	0·74	Zinc 0·421
	99·73 Rose.	99·72 Rose.	99·475 Schaffgotsch.

The formula answering to these analyses is thus stated: $4StSl^{1\frac{1}{2}}+3PlSl$. This supposes the iron, copper and bismuth to be in the state of sulphurets, and as accidental mixtures.

Sp. Gr. 5·5—5·8. H.=2·0—2·5.

Primary form a Right rhombic prism, whose lateral faces are inclined to one another at angles of 101° 20′ and 78° 40′; cleavage perfect perpendicular to the axis of the prism, less so parallel to it; color steel-grey; lustre metallic; streak unchanged; sectile.

Jamesonite, like the preceding species, occurs both in acicular diverging crystals, and in fibrous masses of considerable dimensions. Its perfect cleavage perpendicular to the axis of the prism is sufficiently characteristic. It occurs principally in Cornwall, associated with quartz, and minute crystals of Bournonite; occasionally in Siberia; and disseminated in calcareous spar in Hungary. Also at Valentia d'Alcantara, in the province of Estremadura, Spain.

PLAGIONITE.‡

Zinken. (*Pogg. Ann.*, xxii. 492.) *G. Rose.* (*Ibid.*, xxviii. 421.)

This mineral resembles Zinkenite, though its characters as described, seem to entitle it to the rank of a distinct species.

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* In honor of Professor Jameson of Edinburgh, named by Mohs.

† Rammelsberg's Handwörterbuch, i. 322.

‡ From the Greek, πλάγιος, oblique, from the form of its crystals.

Its constituents were thus determined by H. Rose, and M. Kudernatsch:

Lead	40·52	40·98
Antimony	37·94	37·53
Sulphur	21·53	21·49
	99·99 Rose.	100·00 Kudernatsch.

According to Dr. Thomson, it is a compound of three atoms sesquisulphide of antimony, and two atoms sulphuret of lead. Formula: $3\mathrm{StSl}^{1\frac{1}{2}}+2\mathrm{PlSl}$.

Sp. Gr. 5·4. H. = 2·5.

Color blackish-lead grey. Fracture imperfectly conchoidal. Structure foliated with two cleavages. Brittle. B B, it decrepitates, and fuses readily with the evolution of sulphurous acid, oxide of antimony, and oxide of lead. It gives no traces of copper. With carbonate of soda, after roasting, a button of lead is obtained, which contains a little antimony and silver.

It occurs in the form of octahedrons deeply truncated on both apices, at Wolfsberg in the Hartz. The crystals have been described also as oblique four-sided prisms.

ZINKENITE.

Prof. G. Rose, (*Pogg. Ann.*, vii. 91.) Bisulpho-antimonite of lead, *Thomson*. Lycites Zinkeni, D.

It consists of the following metals:

	Wolfsberg.
Antimony	44·39
Lead	31·84
Sulphur	22·58
Copper	0·42
	99·23 H. Rose.

These numbers give four atoms sulphur, one atom lead, two atoms antimony. Formula: $2\mathrm{StSl}^{1\frac{1}{2}}+\mathrm{PlSl}$; or, as stated by Rammelsberg, $\overset{\prime}{\mathrm{Pb}}\overset{\prime\prime\prime}{\mathrm{Sb}}$.

Sp. Gr. 5·3 — 5·35. H. = 3·0 — 3·5.

Occurs in regular six-sided prisms, terminated by flat six-sided pyramids; the faces of the prism inclined to one another at an angle of 120°, those of the pyramid to the corresponding faces of the prism at 102° 42′. The faces of the prism are usually striated deeply in a longitudinal direction, those of the pyramid, though not furrowed, are uneven. Color steel-grey; lustre bright metallic; streak corresponding to the color; fracture uneven; no traces of cleavage. It is soluble in nitric acid, yielding an immediate precipitate of white antimony. When heated alone on charcoal it decrepitates briskly, and melts as readily as grey antimony; small metallic globules are formed, which are entirely volatile on itinued, while the charcoal is covered with oxide of lead. With soda it yields globules

urs in the antimony mine of Wolfsberg near Hartz, and was named by its original discov- avus Rose, in honor of his friend M. Zinken, of the Anhalt mines. It much resembles both ny and Bournonite in color and fracture, but may ished from them by its superior hardness and spe- ity. Its crystals are aggregated in groups, which columnar composition, and occur on a massive vari- ne same species in quartz. Their length often exceeds inch, their breadth two or three lines; but frequently are extremely thin, and form fibrous masses.—*Allan's nual.*

RED ANTIMONY.

Rothspiesglaserz, W. Antimoine Oxydé Sulfuré, H. Antimoine Rouge, Br. Antimon Blende, L. Prismatic Antimony-Blende, J. Prismatic Purple Blende, M. Cerasia rhomboidea, D.

Combination of the protoxide and sulphuret of antimony.

	Braunsdorf.
Antimony	47·45
Oxygen	4·27
Sulphur	20·47
	99·19 H. Rose.

These numbers give one atom oxide of antimony, and two atoms sesquisulphuret of antimony. Formula: $\underline{\mathrm{S}}\mathrm{t}+2\mathrm{StSl}^{1\frac{1}{2}}$.

Sp. Gr. 4·5—4·6. H.=1·0—1·5.

Primary form an Oblique rhombic prism, whose base, according to Mohs, is inclined to its axis at an angle of 101° 19′. Secondary form, the primary having its edges replaced. Cleavage highly perfect parallel to both sides of the primary prism. Surface striated longitudinally; lustre adamantine; feebly translucent, streak brownish-red; fuses easily on charcoal, by which it is absorbed, and is at last entirely volatilized. When immersed in nitric acid, it becomes covered with a white coating. The capillary variety, in which the individuals are so interlaced as to present flakes resembling tinder, is distinguished by the German mineralogists, under the name of Zundererz or *Tinder Ore.*

By reflected light of a cherry-red, by transmitted light of a crimson color, but commonly tarnished externally with a brownish or bluish tinge, or is iridescent. It forms very fine diverging or interlaced acicular crystals; has a shining lustre, is translucent, and brittle.

d antimony occurs in veins with quartz, accompanying
ınd white antimony, at Malazka near Posing in Hungary;
aunsdorf near Freyberg in Saxony; and at Allemont in
hiné. The principal localities of ***tinder ore,*** are Claus-
nd Andreasberg in the Hartz.

OXIDE OF ANTIMONY.

ntimony. **Weiss Spiesglaserz, W. Antimoine Oxydé, H. Antimoine Blanc, Br.**
atic Antimony Baryte, M. Prismatic White Antimony, J. Spiessglanzweiss.
ıann. Antimony Bloom. Antimonbluthe, L. Stimmius rhombicus, D.

ısists when pure of protoxide of antimony; but usually
ıns silica and oxide of iron. Symbol: $\underline{S}$r.

Sp. Gr. 5·5 — 5·6. H. = 2·5 — 3·0.

or snow-white, yellow, or grey, sometimes peach-blossom
Primary form a Right rhombic prism of 137° 43′ and
′. Generally in tabular and acicular crystals, in diverg-
roups; more rarely massive. Principal cleavage highly
t parallel to the lesser diagonal of the prism; lustre
en pearly and adamantine; translucent; streak white.
lts very easily B B, and is volatilized in the form of a
vapor. With borax it forms a glass which appears yel-
ı while hot, but becomes almost colorless on cooling.
le in nitro-muriatic acid.

ıutiful varieties of aggregated tabular crystals occur with
ores of antimony at Przibram in Bohemia; the acicular
y is found at Braunsdorf in Saxony, Malazka in Hun-

ANTIMONPHYLLITE.

Breithaupt. (*Berzelius' Jahres-Bericht*, 1832, p. 202.)

Sp. Gr. 4·025. H. = 10 — 1·5.

Crystallized in thin unequiangular six-sided prisms, of a greyish-white color; lustre pearly, inclining to adamantine; translucent; sectile; and, when in thin laminæ, flexible like talc. Contains oxide of antimony, a copious precipitate of which is thrown down from its solution in muriatic acid by water. Specimens of this mineral are preserved in the collections of Dresden and Halle, but their locality is unknown.

NATIVE LEAD.

Lead is described as occurring in the metallic state, in small masses, in the lavas of the island of Madeira, and other volcanic districts, forming the *native lead* of some mineralogists. It has lately been found in the neighborhood of Alston, in Cumberland, occurring in small globular masses imbedded in galena, and a slaggy substance, accompanied by red oxide of lead, blende and quartz. The vein in which it is found, traverses limestone. It is said that the lead mines of Michigan, near Anglaise river, have furnished specimens of the native metal.

SULPHURET OF LEAD.

GALENA.

Galena. Bleiglanz, W. Plomb Sulfuré, H. Galène, Bt. Lead Glance, J. Hexahedral Lead Glance, M. Bleisheweif, *Hausmann.* Plumbum Galena, *Linn.* Plumbites cubicus, D.

Its composition is shown by the following analyses:

		Hanover.	Durham.
Lead	79·6	83·00	85·13
Sulphur	13·4	16·41	13·02
Silver	7·0	0·08	0·50
Iron	0·0	0·00	0·50
	99·0 Beudant.	99·49 Westrumb.	98·65 Thomson.

Lead	84·63	84·40
Sulphur	13·21	13·20
Carbonate of lime	0·00	1·40
	97·84 Robertson.	100·00 Beck.*

It consists of one At. lead, one At. sulphur = 86·55 lead, 13·45 sulphur. In Beudant's analysis the silver is included with the lead, giving the same result. Formula: PlSl, or $\overset{,}{\mathrm{Pb}}$.

Sp. Gr. 7·4 — 7·6. H. = 2·7.

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* Mineralogy of New York, p. 49 The specimen was from Rossie, St. Lawrence county, N. Y.

er is very frequently found mixed with galena, and in
nely variable proportions; its presence, however, which
nly be ascertained by cupellation, does not influence
the physical or external characters of the species in any
Externally of a lead-grey color, occasionally blackish-
sometimes irisated superficially. Primary form the
It occurs crystallized in the cube and regular octa-
n, and in some of their varieties; structure lamellar;
ge parallel with the planes of the cube, highly perfect
sily obtained; the fractured surfaces possess a brilliant
ic lustre. It also occurs in amorphous masses, possess-
curved lamellar structure; frequently granular, consist-
small crystalline plates irregularly disposed in regard to
nother; and sometimes almost compact, yielding a flat
oidal fracture, and presenting little lustre. A beautiful
cent tarnish is frequently observable, which is confined
er (as in some other minerals) to the secondary forms;
ces of the octahedron appearing iridescent, while those
cube are not.

, it first decrepitates, but when heated with precaution
lts, and yields, after the sulphur has been driven off, a
le of metallic lead. It is partly soluble in nitric acid,
aves a white residue.

1.

2.

3.

4.

5.

Galena is a mineral of very frequent occurrence, forming veins and beds both in primary and secondary rocks. Veins in gneiss are its repositories at Freyberg in Saxony; veins in primitive limestone at Sala in Sweden; and veins in clay-slate at Clausthal and Neudorf in the Hartz, Przibram in Bohemia, and elsewhere. The grauwacke at Leadhills, and the killas of Cornwall, are equally interspersed with veins of galena; and the rich repositories of Derbyshire, Cumberland, and the northern districts of England, as well as those of Bleiberg, and the neighboring localities in Carinthia, are contained in transition or mountain limestone. The general forms of its crystals are the cube and octahedron, with various intervening modifications. Individuals of very large dimensions have been obtained at Dufton and Alston Moor in Cumberland; at Pfaffenberg near Neudorf, and at Andreasberg, in the Hartz; in Transylvania and Saxony, and from Nertschinsky, Siberia. Leadhills is its principal Scottish locality, though it has been noticed also in large octahedral crystals near Inverkeithing in Fifeshire, at East Calder, the Isle of Isla, and elsewhere. It is associated in the English localities with calcareous and fluor spars, with blende, calamine, barytes, witherite, and pearl spar; in Greenland with cryolite and sparry iron. — *Allan's Manual.*

In the province of Coquimbo in Chili, sulphuret of lead occurs associated with the carbonate and red oxide. At Guancavellica, in Peru, large veins of it are extensively wrought. It is found also near Cocina in the district of Tarapacha, and at Conchi in Bolivia. — *Blake.*

The compact variety chiefly occurs at Freyberg in Saxony, in the Hartz, Carinthia, and at Leadhills. The galena found near Bear Alston, Cornwall, contains from eighty to one hundred and forty ounces of silver per ton of lead.

Probably the most extensive lead mines in the known world are those found in the western section of the United States, particularly in Washington, Jefferson, and Madison counties, Missouri; and at Galena, in the north-west part of Illinois; in Iowa, and the territory of Wisconsin. According to Schoolcraft, who first carefully examined these deposits, galena is found in various places, from the Arkansas river to the North-western territory, in which are found the important mines of Prairie du Chien, once worked by the Sacs and Fox Indians. The ore is in irregular masses, principally in limestone, or imbedded in clay, in which are found numerous detached masses of quartz, sulphate of barytes, besides carbonate, and sulphuret of zinc. It is so abundant that the miners never extend the shafts to a great depth, but usually penetrate about twenty feet through a tenacious mass of red clay, into a stratum consisting of crystalline particles of carbonate of lime. This stratum is nearly horizontal, and varies in thickness from six to twenty feet. It is succeeded by red clay, &c. similar to the superficial stratum.* "The limestone presents vertical fissures, which are filled with clay and masses of lead ore, and they open into what appear to have been large caves, which are encrusted by galena upon the sides, roof and floor. These caves are of large size, large enough to admit wheelbarrows or carts, and the incrustation of a foot or more of galena around their walls, affords no small profit to the proprietors and miners."† The La Motte mines are the oldest and richest in Missouri; were discovered in 1720, and were worked, under the Spanish government, long before the country came into the possession of the United States. The ore yields, in the large way, nearly seventy per cent., a considerable portion being lost in the process. In 1822, the annual product had been upwards of three million pounds of lead. From that time to 1833, the aggregate amount was sixty-three million eight hundred and forty-five thousand seven hundred and forty pounds. In 1843, there were shipped from Galena and Dubuque, and the other points on the upper Mississippi, five hundred and sixty-three thousand seven hundred and thirty-one pigs of lead, weighing thirty-nine million four hundred and sixty-one thousand one hundred and seventy-one pounds, and valued at $937,202.

The galena at the Mineral Point lead mines, Wisconsin, sometimes assumes the form of the fossils contained in the limestone. One specimen is a limestone cast of the ***Pleurotoma angulata*** (Sowerby), of which the upper part of the spine is pure galena. There can be perceived, between the cast and its matrix, a thin plate of galena answering to the space filled by the original shell, which has thus evidently been replaced by the sulphuret of lead. Another is a pure galena cast of a large Turritella; and there is, besides, a specimen consisting of cubic crystals, through which a thin valve of Strophomena is inserted edgeways, shewing that the lead had formed and crystallized around it; it is silicified, and very thin and delicate.‡

There are numerous other localities of sulphuret of lead in the United States, but they are of little comparative importance in a commercial point of view. At Rossie, St. Lawrence county, N. Y., large sums have been expended in working the

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* See Schoolcraft's view of the Lead Mines of Missouri. Also, a paper by Dr. E. James, in the Journal of the Acad. of Nat. Sciences, Phil., v. 376.

† James T. Hodge. Amer. Jour. of Science, xliii. 56.

‡ Many singular specimens of this kind are in the possession of Mr. T. R. Conrad, to whom I am indebted for the above facts concerning them. [Am. Ed.]

Parish and other mines; and in 1838 upwards of three million pounds of lead were obtained from them, but at present these mines are abandoned. They have afforded uncommonly large and beautiful crystals, richly grouped with calcareous spar, and iron and copper pyrites, celestine, etc. At Martinsburg, Lewis county, N. Y., crystals are found similar to fig. 2 and 3, and sometimes with only one of the solid angles of the octahedron replaced. At Lowville, they are associated with green fluor, and six-sided prisms of calc-spar. Fine specimens were formerly found at Perkiomen, Penn., associated with several salts of lead. It occurs also at Southampton, Mass., at Eaton and Shelburne, N. H., and Lubec, Me., with sulphuret of zinc and iron pyrites. Several mines of lead have been opened in Connecticut. That at Brookfield, according to Shepard, is contained in white limestone, and is associated with blende and calamine. That at Monroe, yields an ore very rich in silver, containing, by Prof. Silliman's trials, from 2 to 3·5 per cent. compared with the metallic lead. The only mine at present wrought, besides those in the western States, is that of Davidson county, N. C., where the ore promises to be abundant and richly remunerate the proprietors. It is here associated with carbonate and phosphate of lead, and native silver.

Specular Galena.— Plomb sulfuré speculaire, H. consists of an extremely thin coating of lead on quartz, or some other substance, and exhibits an appearance of polish, and a lustre, from which the name of *Slickenside*, or looking-glass lead ore, has been derived. It is found principally in the mines of Derbyshire.

Blue Lead. — Blau Bleierz, W. Plomb sulfuré prismatique epigène, H. Plomb bleu, Br. Plomb noir, Bt. This is evidently pseudomorphous of phosphate of lead. It occurs massive, likewise in six-sided prisms of a color between lead-grey and indigo-blue, which sometimes are narrower near the terminations than across the middle, and which are superficially dull and rough; the fracture is even, or flat conchoidal, with a glimmering metallic lustre; it is soft, somewhat sectile, and easily frangible. Specific gravity 5·4. It has been found at Zschoppau in Saxony; at Huelgöet near Poullaouen in France, accompanying carbonates of lead and copper; and in the mine of Huel Hope in Cornwall. The prisms internally consist of fibrous galena, occasionally mixed with a translucent substance, of a rich brown color by transmitted light, and greatly resembling some varieties of phosphate of lead; or they consist almost wholly of this substance, the surface only appearing to have passed into the sulphuret; other specimens consist of remarkably compact galena, and they all bear the external appearance of the ordinary sulphuret of lead.

Galena is distinguished from plumbago by its weight, and by its not affording distinct traces on paper; from sulphuret of molybdena also by its structure, which is never foliated; and from the brilliant metallic varieties of blende, by the surfaces of its crystals resuming their lustre instantly when breathed upon, while those of blende remain dull for some time.

The Sulphuret of Lead and Antimony, and the Sulphuret of Lead, Antimony, and Silver, may be classed with this species, the difference in their chemical composition being insufficient to distinguish them otherwise than as varieties.

Sulphuretted Sulphate of Lead.—Is earthy, of various colors from pure white to a deep lead-grey, and so highly inflammable as to take fire and burn on being held in the flame of a candle. It occurs in the Dufton lead mines, in the midst of the regular veins. It is merely a mixture of sulphur with sulphate of lead. Contains, by analysis of Prof. Johnston,[*] sulphur 8·71, sulphate of lead 90·38.

The **Supersulphuret of Lead**, of Dr. Thomson, from the North of England, contains of common galena 98·21, of sulphur 1·79, or seven At. lead, eight At. sulphur. B B, on charcoal, it burns with a blue flame, then decrepitates, melts, and leaves a globule of metallic lead. Heated in a glass tube the sulphur sublimes, and the common galena remains.

Argentiferous Galena is not supposed to be an atomic combination, as the specimens, on analysis, give very different proportions of silver.

The lead mines of Great Britain produce annually from forty-five to forty-eight thousand tons of smelted lead, which is principally obtained from the sulphuret.

COBALTIC GALENA.

Cobaltic Galena, or Cobaltic Lead Glance, J. and M. Cobaltbleierz, *Hausmann.* Plumbites Cobalticus, D.

Sp. Gr. 8·44. Soft and sectile.

Contains lead 62·89, arsenic 22·47, sulphur 0·47, iron 2·11, cobalt 0·94, arsenical pyrites 1·44 (the loss of 9·76 being attributed to intermixed calcareous spar)—Du Menil. Formula, supposing the lead and arsenic only as essential, PlAs. It occurs in minute moss-like groups of crystals, or cleavable masses. Color lead-grey, inclining to blue; opake; lustre metallic and shining. Soils a little. Splits into fragments B B, and communicates a smalt-blue color to glass of borax.

It occurs in a vein of clay-slate with brown spar, traversing grauwacke, at Clausthal in the Hartz.

BOURNONITE.[†]

Triple Sulphuret. Endellione, *Bournon.* Schwarz Speissglaserz, W. Spiesglanzbleierz, *Klaproth.* Bleifahlerz, *Hausmann.* Plombe Sulfuré Antimonifère (in part), H. Diprismatic Copper Glance, M. Axifrangible Antimony-Glance, or Bournonite, J. Cyprites rectangulus, D.

Combination of sulphuret of lead, sulphuret of copper, and sulphuret of antimony.

	Clausthal.	Pfaffenberg.	Cornwall.		Mexico.
Lead	42·50	40·84	41·0	42·62	40·2
Sulphur	18·00	20·31	20·0	17·00	17·8
Antimony	19·75	26·28	25·0	24·23	28 3
Copper	11·75	12·65	13·0	12·80	13 3
Iron	5·00	0·00	0·0	1·20	0·0
	97·00 Klap.	100·08 H. Rose.	99·0 Smithson.	97·85 Hatchett.	99·6 Dufrénoy.

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[*] Report of British Association for the Advancement of Science, (1832,) p. 572.

[†] Bournonite, in honor of the Comte de Bournon, who first described this mineral, and who gave it the name of Endellione, from the parish in Cornwall in which it was found.

The mean of the above analyses gives the following numbers:

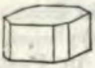
		Atoms.	
Sulphur	18·62	9·31	3
Lead	41·37	3·18	1
Antimony	24·71	3·09	1
Copper	12·74	3·18	1

These numbers obviously correspond with three At. sulphur, one At. antimony, one At. lead, one At. copper: or, the mineral is composed of one At. StSl, one At. PlSl, one At. CpSl. Formula: StSl+PlSl+CpSl.

Sp. Gr. 5·79—5·83. H. = 2·5—3·0.

Color approaching to steel-grey, with a shining lustre; but occasionally the crystals appear of a dull lead-grey, with a tinge of black. Primary form a Right rectangular prism. It occurs crystallized in this form, variously modified; structure lamellar, affording cleavage planes parallel to the lateral faces of the primary and both its diagonals; fracture uneven or flat conchoidal, with a brilliant metallic lustre; it is very brittle, and yields to the pressure of the nail. B B, it decrepitates, then melts, emitting a white sulphurous vapor, after which there remains a crust of sulphuret of lead, enclosing a globule of copper. Readily soluble in heated nitric acid.*

1.



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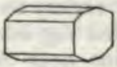

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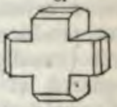
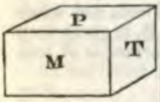
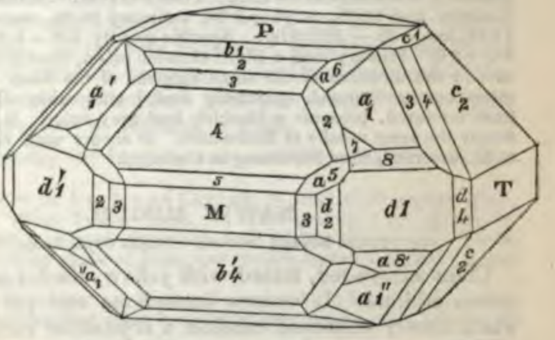


Fig. 1, a rectangular prism, of which the lateral edges are replaced, converting the crystal into an eight-sided prism. In fig. 2, two opposite edges of each terminal plane are replaced by planes inclining on the terminal planes, so as to reduce them greatly. Fig. 3, a macle, in which two crystals similar to fig. 2, but elongated, cross each other.

Primary.





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* The solution is of a sky-blue color, and gives, with sulphuric acid, a white precipitate of sulphate of lead; producing, with excess of caustic ammonia, an azure blue solution. — Von Kobell.

M on T	90°	00′	*a*1 on *a*3	165°	00′
P on M or T	90	00	— — *a*4	150	20
— — *a*1 or *a*1′	146	48	— — *a*5	147	35
— — *b*1	175	50	— — *a*6	179	24
— — *b*2	165	00	— — *a*7	164	5
— — *b*3	154	00	— — *a*8	168	00
— — *b*4	136	30	— — *b*4	152	36
— — *c*1	173	15	— — *c*2	146	35
— — *c*2	136	9	*b*4 on *b*4′	87	30
M on *a*1 or *a*1′	114	00	— — *d*1	120	20
— — *a*5	143	20	— — *a*5	151	30
— — *b*2	115	15	— — *c*2	119	22
— — *b*4 or *b*4′	133	40	*c*2 on *c*2′	88	00
— — *b*5	151	52	*d*1 on *a*1 or *a*1″	123	15
— — *d*1 or *d*1′	136	48	— — *a*5	149	5
— — *d*3 or *d*3′	154	48	— — *a*7	132	52
T on *a*1	109	50	— — *a*8 or *a*8′	142	40
— — *c*2	134	00	— — *d*1	93	40
— — *d*1	133	00	*d*1 on *d*2	168	33
*a*1 on *a*1″	66	30	— — *d*3	161	58
— — *a*2	175	10	— — *d*4	172	15

The most magnificent crystals of Bournonite are found in the mines of Neudorf in the Hartz, where they occasionally exceed an inch in diameter. It occurs accompanying quartz, fahlerz, and phosphorescent blende, at Kapnik in Transylvania, in compressed crystals, which, from their peculiar macled arrangement, produce the variety termed in German *radelerz* or wheel-ore (usually called *cog wheel-ore*); also with pearl spar and quartz, at a mine near Servos in Piedmont; at Braunsdorf and Gersdorf in Saxony; at Clausthal and Andreasberg in the Hartz; in some of the gold mines of Hungary and Transylvania; in Peru; in Mexico, and in Cornwall.

PRISMATOIDAL COPPER GLANCE. — Prismatoidal Copper Glance, M. Prismatic Antimony-Glance, J. Cuivre Sulfuré Prismatoïde, *Necker.* Contains lead 29·90, sulphur 8·60, antimony 16.65, arsenic 6·04, copper 17·35, iron 1·40 — *Schrotter.* Specific gravity 5·7 — 5·8. Hardness = 2·0 — 3·0. Primary form a Right rhombic prism, cleavable parallel to the axis in the direction of the small diagonal of the base. It is generally somewhat decomposed, externally coated with oxide of iron, and when fresh fractured, presents a blackish lead-grey color. B B, it gives very nearly the same results as Bournonite. It occurs with carbonate of iron at St. Gertraud, near Wolfsberg in Carinthia.

NATIVE MINIUM.

Native Minium, *Smithson.* Plombe Oxydé Rouge, H.

Color aurora-red, mixed with yellow, similar to that of factitious minium. It occurs amorphous and pulverulent, but when closely examined exhibits a crystalline structure. B B, on charcoal, it is first converted into litharge, and then into metallic lead. It is supposed to be an oxide of lead, and to arise from the decomposition of galena, in veins of which it commonly occurs. According to Mr. Smithson it possesses the properties of sesquioxide of lead.

It is found in Grassington Moor in Craven, and at Grasshill Chapel, in Weirdale, Yorkshire. On the continent, near Badenweiller; and in Siberia.

At the lead mines in Weythe county, Virginia, according to Prof. W. B. Rogers, red oxide of lead, mixed with a small proportion of yellow oxide, has until lately been mistaken for ferruginous clay and disregarded, but it is now highly valued for its productiveness in metal.

SELENIURET OF LEAD.

Selenblei. Plomb Seleniuré, *Levy*. Clausthalie, *Beudant*. Seleniet of lead, *Thomson*. Plumbites Selenicus, D.

	Clausthal.	Tilkerode.	Atoms.
Lead	70·98	71·81	5·49
Selenium	28·11	27·59	5·57
Cobalt	0·83	0·00	
	99·92 Turner.*	99·40 H. Rose.	

It is obviously a simple seleniuret of lead. Formula: PlSel.

Sp. Gr. 8·2—8·8, Haidinger; 6·7—6·8, Silliman.

Crystalline form unknown. Color lead-grey inclining to bluish; lustre metallic; cleavage indistinct; fracture granular and shining. Bears considerable resemblance to fine granular galena. B B, on charcoal, it is quickly decomposed, and affords, besides the usual phenomena arising from the presence of lead, the odor of decayed horse-radish, a brownish matter being at the same time deposited on the charcoal; heated over the spirit-lamp in a glass tube closed at one extremity, the selenium almost instantly sublimes, and forms a red ring within the tube, at the open extremity of which its peculiar odor is very perceptible. It is a rare substance, occurring only in the massive state in veins of hematite, near Clausthal, and Tilkerode in the Hartz, sometimes with particles of native gold. It was discovered by M. Zinken in 1823.

At the latter locality the following compounds have likewise been met with.

1. **Seleniuret of Lead and Copper.**—Lead 47·43, copper 15·45, selenium 34·26, silver 1·29.—*Rose*. Specific gravity 7·0. Occurs in amorphous masses of a lead-grey color. Is ductile and sectile. Fuses readily B B, yielding oxide of lead, and reddish metallic grains. Acted upon by nitric acid.

This mineral, *Séléniure cuivre-plombique*, has been found by M. Kersten, at the Fredericksglück mine near Hildbourghausen, with seleniet of lead.

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* Rammelsberg (Handwörterbuch, ii. 140) credits this analysis to Stromeyer, and refers to Poggendorf's Annalen, ii. 403.

2. **Seleniuret of Lead and Cobalt.** — Lead 63·92, cobalt 3·14, selenium 31·42, iron 0·45. — *H. Rose.* Specific gravity 7·697. Has much the aspect of seleniuret of lead. Gives off in the closed tube a sublimation of selenium, and exhibits with the fluxes the re-action of cobalt, by coloring them blue.

3. **Seleniuret of Lead and Mercury.** — Lead 55·84, mercury 16·94, selenium 24·97. — *H. Rose.* Specific gravity 7·8 — 7·87. Exhibits a very distinct cubical cleavage. In the matrass yields a crystalline sublimation of the seleniuret of mercury.

The first variety, according to Dr. Thomson, consists of one At. seleniet of lead, eight At. seleniet of copper; the second of five At. seleniet of lead, one At. seleniet of cobalt; the third of three At. seleniet of lead, one At. sesquiseleniet of mercury. See table of formulas.

PLOMBGOMME.

Bleigummi. Hydrous Aluminate of Lead, *Smithson.* Plomb Hydro-Alumineux, H. Sexaluminate of lead, *Thomson.* Cronalus resiniformis, D.

Combination of the oxide of lead, alumina, and water.

	Huelgoet.	Atoms.	
Protoxide of lead	40·14	2.87	1
Alumina	37·00	16·44	5·72
Water	18·80	16·71	5·82
Sulphurous acid	0·20		
Lime, oxides of iron and manganese	1·80		
Silica	0·60		
	98·54 Berzelius.		

Supposing the alumina to act the part of an acid, it is an aluminate of lead, as thus atomically expressed by Dr. Thomson: $\underline{\mathrm{Pl}}\mathrm{Al}^6+6\mathrm{Aq}$.

Sp. Gr. 6·425. H. = 4·0 — 5·0.

This mineral is of a yellow color, sometimes tinged with brown. It occurs in small reniform masses, composed of many concentric spherical layers, which are externally splendent, often resembling mammillated chalcedony, sometimes possessing a degree of pearly lustre on their inner surfaces, and occasionally irisated. The concentric layers, when broken across, are without splendor, and rarely present slight appearances of a radiated texture, but are without any regular crystalline structure. Fracture conchoidal; translucent. When suddenly heated it decrepitates violently; but when approached with caution it becomes white and opake, although it does not fuse. With borax it forms a colorless transparent glass, but without reducing the lead, which, however, is effected on the addition of soda. It acquires negative electricity by friction.

It was supposed to occur only at Huelgoet near Poullaouen in Brittany, associated in clay-slate with galena, blende, and iron pyrites. But more recently it has been brought from Nussiene in the neighborhood of Beaujeu, in France. There are certain varieties of mammillated blende to which it bears much resemblance.

BITELLURET OF LEAD.

Dr. Thomson. (*Outlines*, &c., i. 555.)

This is the mineral from Altai, first described and analyzed by Prof. G. Rose, and hitherto classed with black tellurium. Its constituents were found by him to be as follows:

		Atoms.
Tellurium	38·37	9·6
Lead	60·85	4·69
Silver	1·28	0·09
	100·50*	

If we include the silver with the lead, the atoms of tellurium are almost exactly twice those of the lead. Formula: PlTl^2.

Sp. Gr. 8·159. H. not stated.

Color tin white, very similar in appearance to that of native antimony, sectile, easily reducible to a fine powder. B B, on charcoal, gives a blue tinge to the flame. In the reducing flame melts into a bead, which becomes smaller and smaller, and at last leaves nothing but a minute globule of silver. Round the assay is formed a metallic shining ring of telluret of lead; at a little further distance a brownish yellow matter, which tinges the flame blue, and is totally dissipated by heat.

CARBONATE OF LEAD.

Diprismatic Lead Baryte, M. Weiss Bleierz, W. Plombe Carbonaté, H. Ceruse, *Beudant.* Kohlensaures Blei, L. White Lead Ore, J. Cronalus rhombicus, D.

Combination of carbonic acid, and protoxide of lead.

	Leadhills.	Zellerfeld.	Nertschinsk.		Atoms.
Carbonic acid	16·0	16·0	15·5	16·418	5·966
Protoxide of lead	82·0	81·2	84·5	83·534	5·966
Lime	0·0	0·9	0·0	Water.. 0·060	
Oxide of iron	0·0	0·3	0·0	0·000	
	98·0 Klaproth.	98·4 Westrumb.	100·0 John.	100·000 Thomson.	

The last analysis gives exactly, and the others very nearly, one atom of each constituent, and the mineral is therefore a simple carbonate of lead. Formula: $\mathrm{Pl}\dot{\mathrm{C}}$.

Sp. Gr. 6·3—6·6. H. = 3·0—3·5.

Primary form a Right rhombic prism. Either colorless or white, passing into grey and greyish-black; tinged also green and blue by admixture with ores of copper. It occurs in tabular crystals, in six-sided prisms variously terminated, and in other macled crystals of different forms. It cleaves parallel to the planes P, M, and M′ of the following figures, but not distinctly, being frequently interrupted by conchoidal fracture;

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* Poggendorf's Annalen, xviii. 68.

the lustre of the planes produced by cleavage is somewhat adamantine; the fracture small conchoidal, with a resinous lustre; transparent or translucent; when transparent it is doubly refractive in a high degree; very brittle. It also occurs massive. Its powder thrown upon live coal emits phosphorescent light. B B, it decrepitates, becomes yellow, then red, and is immediately reduced to the metallic state, the charcoal being covered with the yellow fumes of lead; with the fluxes it forms a diaphanous glass. It effervesces in dilute muriatic acid, especially if warm.

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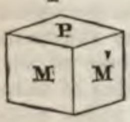

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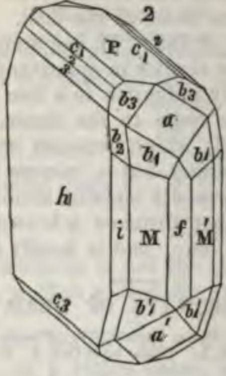
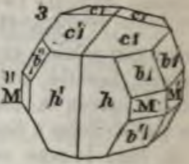


Macles.

3



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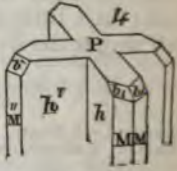

M on M′	117°	00′	*a* on *a*′	67°	12′
P on M or M′	90	00	*a* on *b*1 or *b*1	149	00
—— *a*	149	14	*b*1 on *b*1	130	00
—— *f*	90	00	—— *b*2	162	6
—— *h*	90	00	—— *b*3	160	32
M or M on *a* or *a*′	115	30	*c*1 on *c*1	140	20
M or M′ on *f*	148	32	—— *b*1	134	00
M on *b*1 or M′ on *b*1′	144	15	—— *b*3	151	00
—— *b*2 ———— *b*2	146	12	*h* on *c*1	109	16
—— *b*3 ———— *b*3	124	42	—— *c*2	125	43
—— *c*1	100	24	—— *c*3	145	16
M on *h*	121	26	—— *i*	151	21
—— *i*	150	00	M on M″ (macles)	125	30

There are few substances whose crystallizations are more complex than the carbonate of lead. The circumstance, too, of its crystals being usually macled, in general small, and the number of their facets very numerous, accounts for its having long puzzled mineralogists.

Leadhills and Wanlockhead are well known as the Scotch localities of this mineral; it there occurs with other ores of lead, particularly the phosphate, sulphate, sulphato-tri-carbonate, and cupreous-sulphate, accompanying galena in transition-slate. Very beautiful crystals are found in the mining districts of Saxony, particularly at Johanngeorgenstadt; at Nertschinsk and Beresof in Siberia, near Bonn on the Rhine, at Clausthal in the Hartz, at Tarnowitz in Silesia, at Bleiberg in Carinthia, and at Mies and Przibram in Bohemia. In England it has also been met with at Alston Moor, at Keswick, and in Cornwall, where, particularly at the mine of St. Minvers, it occurs in snow-white and easily frangible acicular crystals, so delicate as almost to preclude the possibility of transport. — *Allan's Manual.*

Within the last five years a remarkable locality of this mineral has been discovered in Davidson county, N. C., specimens of which, from their pure, white silky lustre, and their beautifully delicate crystallizations, are rarely surpassed by the finest from Saxony. Interesting specimens of this mineral were formerly found at the Perkiomen lead mine, Penn., and a choice selection of them, comprising various crystalline modifications, may be seen in the rich collection of minerals belonging to J. P. Wetherell, Esq., of Philadelphia. The mine is now abandoned. The lead mines in Weythe county, Virginia, yield, in some instances, quite a large proportion of carbonate, of which beautifully pure crystalline specimens are quite common. It was found by Mr. Hodge, at the Mine La Motte, Missouri, in beautiful white crystals, with carbonate of copper. It occurs sparingly with the galena at Lubec, Maine.

EARTHY CARBONATE OF LEAD. — Bleierde, W. Plomb carbonaté terreux, H. Indurated and friable earthy lead-ore, J. Color grey, occasionally tinged green, yellow, or red, also reddish-brown; massive, disseminated and pulverulent; commonly dull and opake, sometimes friable, soft, and heavy. It occurs in several European countries, commonly associated with the preceding.

SULPHATO-CARBONATE OF LEAD.

LANARKITE.

Prismatoidal Lead Baryte, *Haidinger.* Schwefel und Kohlensaures Blei *of the Germans.* Lanarkite, *Beudant.* Dyoxylite, *Shepard.* Cronalus flexilis, D.

Composed, according to the analyses of Brooke and Dr. Thomson, of

Carbonate of lead	46·9	46·04
Sulphate of lead	53·1	53·96
	100·0 Brooke.[*]	100·00 Thomson.

These numbers give exactly one atom carbonate of lead, one atom sulphate of lead. Formula: $\underline{P}l\dot{C}+\underline{P}l\dot{S}l$.

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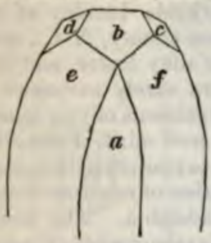
[*] See Edin. Phil. Jour., iii. 117, in which Mr. Brooke has described several new salts of lead, from Leadhills, Scotland.

Sp. Gr. 6·8 — 7·0. H. = 2·5.

Color greenish-white, pale-yellow, or grey. Primary form a Right rhombic prism of 59° 15′ and 120° 45′. The crystals are seldom distinct, always minute and aggregated lengthwise, presenting a character approaching to fibrous; and owing to their minuteness, the relations of the planes of the following figure, to those of the primary crystal, have not been ascertained. Cleavage perfect and easily obtained, parallel to a plane which replaces the acute lateral edges of the primary; the laminæ resulting from cleavage are flexible, like gypsum; lustre adamantine; streak white; translucent.



a on *b*	111°	00′
b on *b* over summit	130	5
a on *c*	106	45
—— *d*	73	45
—— *e*	123	20
c on *f*.	133	0
d on *e*	136	54

It is soluble in nitric acid without perceptibly effervescing, leaving a residue of the sulphate of lead; and B B, on charcoal fuses into a globule which is white when cold, and is nearly reduced to metallic lead.

Until Mr. Brooke analyzed and published a description of it in 1820, this mineral was supposed to be a variety of carbonate of lead. It occurs among other species of lead ore at Leadhills in Scotland. A massive variety has also been brought from Siberia.

SULPHATO-TRI-CARBONATE OF LEAD.

SUSANNITE.

Axotomous Lead Baryte, M. Rhombohedrischer Schwefel Kohlensaures Blei, *Leonhard.* Leadhillite, *Beudant.* Susannite, *Brooke.* Rhomboidal Carbonate of Lead. Cronalus acrotomus, D.

It is composed of

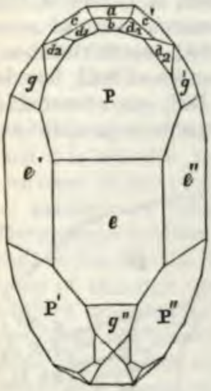
Carbonate of lead	72·5	72·7	71·1
Sulphate of lead	27·5	27·3	30·0
	100·0 Brooke.	100·0 Stromeyer.	101·1 Berzelius.

Carbonate of lead	68·0	72·57
Sulphate of lead	29·0	27·43
	97·0 Irwing.	100·00 Thomson.

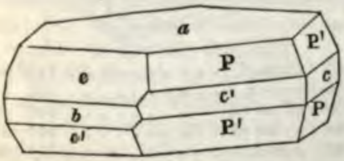
Its constitution is three atoms carbonate of lead, one atom sulphate of lead, and hence the propriety of the name given by Brooke. Formula: $3\underline{P}|\dot{C}+\underline{P}|\dot{S}|$.

Sp. Gr. 6·2 — 6·4. H. = 2·5.

Color white, passing into pale-yellow, green, or grey. This species occurs, as carbonate of lime does, under two different crystalline forms. According to Brooke, the primary form is an Acute rhomboid of 72° 30′ and 107° 30′. As determined by the optical investigations of Sir David Brewster, and the crystallographical researches of Haidinger, the primary form is an Oblique rhombic prism of 120° 20′ and 59° 40′.[*] The crystals seldom exceed an inch in diameter, generally they are much smaller, and when macled, as is not unfrequently the case, they present forms which are with difficulty determinable. Cleavage perfect and easily obtained parallel to *a*, of each of the following figures, or perpendicular to the axis of the acute rhomboid, and Right rhombic prism, according to Brooke. It is translucent; streak white; lustre resinous, inclining to adamantine; pearly on the face *a*, which is one of the most distinguishing characteristics of the species. B B, it intumesces and becomes yellow, but re-assumes its white color on cooling. It effervesces briskly in nitric acid, leaving a white residue of sulphate of lead.



P on P′ or P″	107°	30′	B.
P′ on P″	72	30	
P on *a*	111	30	
a on *g*	111	30	
—— *d*1	131	58	



a on *b*	90°	29′	H.
c on *a*	90	14	
P on *a*	111	42	
P′ on *a*	111	18	
g on *a*	128	23	
g′ on *a*	128	5	
e on *c*	120	20	
b on *c*	119	50	

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[*] Brooke regards this as a Right rhombic prism, M on M′ = 120°. (Art. Mineralogy, Encyclopædia Metropolitana, p. 501.) I have here inserted Brooke's original figure, which has been omitted by Mr. Allan, and which represents the most commonly occurring secondary form of this mineral. [AM. ED.]

This substance also occurs with other ores of lead at Leadhills, Scotland; and under similar circumstances it has been found in Spain.

CUPREOUS SULPHATO-CARBONATE OF LEAD.

CALEDONITE.

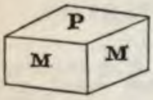
Paratomous Lead Baryte, *Haidinger.* Schwefel und Kohlensaures Blei und Kupfer *of the Germans.* Calcedonite, *Beudant.* Cupreous Sulphato-Carbonate of Lead, *Brooke.* Cronalus diatomous, D.

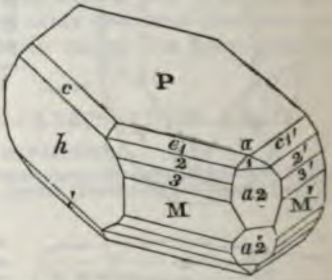
Its constituents, as determined by Brooke's analysis, are carbonate of lead 32·8, carbonate of copper 11·4, sulphate of lead 55·8; corresponding very nearly with $7\frac{1}{2}\underset{.}{P}l\dot{S}l+5\underset{.}{P}l\dot{C}+4\underset{.}{C}p\dot{C}$.

Sp. Gr. 6·4. H.=2·5—3·0.

Color bright verdigris-green, or bluish. Primary form a Right rhombic prism of 95° and 85°, parallel to the planes of which it cleaves indistinctly. It also cleaves in a direction parallel to the shorter diagonal of the prism, *i. e.* to plane *h* of the following figure; the planes M and M′ often appear as a dihedral termination to prismatic crystals. Sometimes its crystals are large and well defined, at others it appears in small tufts radiating from their common point of attachment. Translucent; streak greenish-white; lustre resinous; rather brittle. It is not so hard as carbonate of lead, but is harder than the sulphato-tri-carbonate. B B, on charcoal it is reduced. Soluble with feeble effervescence in nitric acid, leaving a residue of sulphate of lead.

Primary.





M on M′	95°	00′	M on *e*1	144°	00′
P on M or M′	90	00	—— *h*	132	42
—— *a*2	108	00	*a*2 on *a*2′	143	42
—— *c*	126	00	-- on *e*2	140	40
—— *e*1 or *e*1′	126	00	*c* on *h*	144	30
—— *e*2 or *e*2′	115	30	*e*1 on *e*1′	108	00
—— *h*	90	00	*e*2 on *e*2′	128	35

The above figure and measurements are by Brooke.

It is found, with the two preceding varieties of lead ore, at

Leadhills in Scotland, and was shown to be a new mineral by Brooke. — *Edinb. Phil. Journ.*, iii. 19. It is the scarcest of all the lead ores that have been found at the Lead hills. It had before been regarded as a green carbonate of copper.

OXIDO-CHLORIDE OF LEAD.

CERASITE.[*]

Berzelite, *Levy*. Muriate of Lead, P. Peritomous Lead Baryte, M. Saltsaures Blei von Mendip *of the Germans*. Dichloride of Lead. Kerasite. Oxido-Chloride of Lead, *Thomson*. Cronalus peritomus, D.

Composition not exactly determined, it being difficult to ascertain whether the carbonate of lead, which is in small proportions in this species, is combined, or only mixed with it. Berzelius supposes it to be a combination of one atom of chloride, with two atoms of the oxide of lead, mixed with carbonate of lead, and gives this formula: $\mathrm{Pb}\bar{\mathrm{C}}\mathrm{l}+2\dot{\mathrm{P}}\mathrm{b}$, which requires 61·62 oxide of lead, 38·38 chloride of lead. In the specimens analyzed by Berzelius, there were accidentally present about three per cent. of carbonic acid, and a little water and silica.[†]

Sp. Gr. 7·0 — 7·1. H. = 2·5 — 3·0.

Occurs in crystalline masses, having a fibrous and radiated columnar structure. Primary form a Right rhombic prism of 102° 27′ and 77° 33′, parallel to all the faces of which it cleaves with facility. Color white, with a yellow or reddish tinge; feebly translucent or opake; and presenting a pearly lustre on the faces of cleavage. Fracture conchoidal or uneven. B B, on charcoal it is reduced, and emits fumes of muriatic acid; and in a mixture of salt of phosphorus and peroxide of copper the flame assumes an intense blue color. Is soluble with slight effervescence in dilute nitric acid.

Churchill in the Mendip Hills of Somersetshire, is the principal locality of this rare species; it is there found disposed on earthy black manganese. It also accompanies the muriocarbonate of lead at Cornwall, in the form of very thin irregularly curved transparent crystals, without any well defined lateral or terminal planes, as described by Brooke. It is said to occur as a product of sublimation upon the lava of Vesuvius; but from that locality the specimens are so indistinct as to render its identity doubtful.

The *Dichloride of Lead*, of Dr. Thomson, appears to be the same mineral which he has described as an oxido-chloride of lead, he having calculated its composition from a different view of the analytical results of Berzelius, as stated in *Allan's Manual*, from which he had copied them.[‡]

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[*] From κερας, horn.

[†] Poggendorf's Annalen, i. 272.

[‡] See Outlines, &c., i. 557.

CHLORIDE OF LEAD.

COTUNNITE.

Cotunnia, *Monticelli* and *Covelli*. Cotunnite, *Kobell*. Cronalus Vesuvianus, D.

It contains, according to Berzelius:

		Atoms.
Lead	74·52	5·7
Chlorine	25·48	5·66
	100·00	

It is thus a simple chloride of lead. Formula: PlChl.

Sp. Gr. 1·897. Slightly scratched by the nail.

In extremely minute acicular crystals of a white color. Lustre adamantine, occasionally silky, or pearly. Fuses with facility before the blowpipe, coloring the flame blue, and emitting a white smoke, which is condensed on the charcoal; with soda globules of reduced lead are formed; in the matrass it fuses and is sublimated; and in about twenty-seven times its weight of cold water is entirely dissolved.

This substance was observed by Monticelli and Covelli in the crater of Vesuvius, after the eruption of 1822; it was accompanied with muriate of soda, muriate and sulphate of copper, and other salts. It is named in compliment to one of the medical men of Naples. — *Allan's Manual.*

CHLORO-CARBONATE OF LEAD.

Hornblei, W. Plomb Corné, Br. Plomb Muriaté, Bt. Corneous Lead-Ore, J. Blei-Hornerz, *Leonhard*. Plomb Murio-Carbonaté, *Levy*. Brachytypous Lead Baryte, M. Kerasine, *Beudant*. Murio-Carbonate of Lead. Cronalus quadratus, D.

This mineral from the results obtained by Klaproth, and corrected by Dr. Thomson, is composed as follows:

		Atoms.
Chlorine	13·56	3·01
Carbonic acid	8·51	3·09
Lead	39·17	3·01
Protoxide of lead	43·32	3·09
	104·56*	

It thus appears to be constituted of one atom chloride of lead, one atom carbonate of lead. Formula: $\text{Pl}\dot{\text{C}}+\text{PlChl}$.

Sp. Gr. 6·0 — 6·1 H. = 3·0.

Color white, greyish, or yellow. Primary form a Right square prism; in which it occurs either perfect, or having the lateral and also the terminal edges, and its solid angles, replaced. It affords bright cleavages parallel to all the primary planes, and to both the diagonal planes of the prism; structure lamellar; fracture conchoidal, with a splendent adamantine lustre; transparent or translucent; sectile, and easily frangible. B B, on charcoal it fuses into a transparent globule, which becomes pale-yellow on cooling. With salt of phosphorus, mixed with deutoxide of copper, it colors the flame green or bluish-green.

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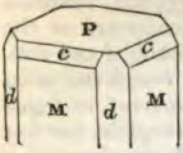
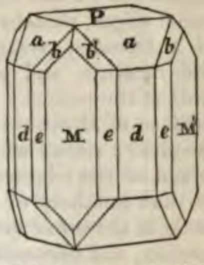
* This excess is owing to a slight overrating of the oxide of lead, and the carbonic acid in the mineral.



P on M . . .	90°	00′
P on *a*	123	6
P on *b*	112	22
M on *a*	126	20
M on *b*	145	47
M on *d*	135	00
M on *e*	153	26



The smaller figure is from a crystal in the British Museum, a Cornish specimen, and the other from one in the possession of Brooke, by whom all the measurements of both have been determined. He remarks, that from the inclination of P on *a*, the ratio of a terminal edge to a lateral edge, is found to be as 35 to 38 very nearly.*

The finest crystals of this species have been obtained in Cromford Level, near Matlock in Derbyshire, with carbonate and sulphuret of lead and fluor. Of these some splendid specimens, exceeding an inch in length, are preserved in the British Museum. More recently very fine crystals have been brought from Cornwall, where it is accompanied by chloride of lead. It is described also as occurring at Badenweiller in Germany.

In the United States a few specimens of a green color, on galena and blende, were many years since discovered, at the lead mine, Southampton, Mass.

PHOSPHATE OF LEAD.

Rhombohedral Lead Baryte (in part), M. Phosphorsaures, Blei, *Leonhard*. Pyromorphite, *Beudant*. Grün Bleierz, W. Plomb Phosphaté, H. Brown Lead Ore. Cronalus hexagonus, (Var. speciosus,) D.

Combination of protoxide of lead, phosphoric acid, and muriatic acid.

	Huelgoet.		Tschopau.
Protoxide of lead	78·58		74·216
Phosphoric acid	19·73		15·727
Muriatic acid	1·65	Chloride of lead	10·054
	99·96 Klaproth.		99·997 Wöhler

Formula by Beudant from the last analysis: $3\dot{\mathrm{Pb}}^3\ddot{\bar{\mathrm{P}}}+\mathrm{PbCh}^2$.

Sp. Gr. 6·9—7·0. H. = 3·5—4·0.

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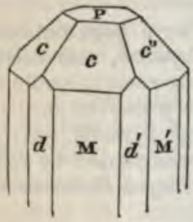
* Article by Brooke, Lond. and Edinb. Phil. Journ., new series, xi. 175; since the date of the last edition of this work.

It is of various shades of green, yellowish-green, yellow ash-grey, and brown. Primary form the Regular six-sided prism, in which it also occurs crystallized, generally, however, modified on the edges; traces of cleavage are visible parallel to all the faces of the prism *c c′ c″* replacing its terminal edges, thereby affording cleavages parallel to the planes of a six-sided pyramid; it also occurs botryoidal, reniform and massive, and often barrel-shaped, or contracted at the ends of the prisms. Fracture imperfect conchoidal and dull. Surface of M always striated horizontally; P rough and often indented; streak white or yellow; semi-transparent to translucent on the edges; lustre resinous; easily frangible, but less so than sulphate or carbonate of lead. B B, on charcoal it melts in the outer flame into a globule, which crystallizes on cooling, and becomes brown; in the reducing flame the globule appears bluish, is luminous while hot, and on cooling crystallizes with large facets of a lighter color, approaching the aspect of mother-of-pearl. It is acted upon by nitric acid.



M on M′	120°	00′
P on M or M′	90	00
M or M′ on *d′*	150	00
M on *c′* or M′ on *c″*	131	45
P on *c* or *c″*	138	30
c′ on *c* or *c″*	110	5

It occurs with galena in primitive and secondary rocks. Finely crystallized specimens are found at Zschopau and other places in Saxony; at Przibram and Mies in Bohemia; at Badenweiller in Baden; in Cornwall; at the Leadhills in Scotland; and in Siberia. The brown varieties occur principally at Poullaouen and Huelgoet in Brittany, at Wanlockhead in Scotland, and at Bleistadt in Bohemia. At the last named locality the crystals have their extremities enlarged into a kind of capping, retaining the same hexagonal shape, and appearing not unlike the blunt head of a nail.

In the United States, extremely rich specimens of this mineral have been met with in the Washington Lead Mine, Davidson county, N. C., associated with other salts of this metal, and sometimes with native silver. At Perkiomen, Penn., small hexahedral prisms were found several years since.

Chromo-phosphate of Lead.—*Dr. Thomson.* This occurs in crystals having precisely the same form with the simple phosphate of lead, and is found in the Wanlock Head Mine, Scotland, in considerable quantity. It is of a beautiful orange-yellow color, without any of the red tinge, which characterizes chromate of lead. It has not been analyzed, but Dr. Thomson found it to contain two per cent. of chromate of lead mixed also with chloride of lead.*

POLYSPHÆRITE.

Breithaupt. (*Berzelius' Jahres Bericht*, 1832, p. 202.)

Sp. Gr. 5·83 — 5·89. H. = 3 — 4.

In roundish masses, having internally a radiated structure; color brown or yellow; lustre greasy; fracture conchoidal. It scratches mica, but is scratched by fluor spar. Contains oxide of lead, phosphoric acid, and magnesia. From the mines of Freyberg in Saxony, where it accompanies blende, galena, quartz, and iron pyrites. — *Allan's Manual.*

ARSENIATE OF LEAD.

Plomb Arseniaté, H. Rhombohedral Lead Baryte, M. Rhombohedral Lead Spar, J. Mimetèse, *Beudant.* Arseniksaures Blei, *Leonhard.* Gorlandite, *Brooke.* Cronalus hexagonus, (Var. alliaceus,) D.

Combination of arsenic acid, muriatic acid, and oxide of lead.

	Johanngeorgenstadt.		Cornwall.
Protoxide of lead	75·59	77·50	69·76
Phosphoric acid	1·32	7·50	0·00
Arsenic acid	21·20	12·50	26·40
Muriatic acid	1·89	1·50	1·58
	100·00 Wöhler.	100·00 Rose.	97·74 Gregor.

Beudant, adopting the first analysis, gives the proportion of oxide of lead as 67·89, and chloride of lead 9·60; according to which the formula is thus stated by him: $3\dot{\mathrm{Pb}}^3\overset{\therefore}{\mathrm{A}}\mathrm{r}+\mathrm{PbCh}^2$.

Sp. Gr. 6·9 — 7·3. H. = 3·5 — 4·0.

Color various shades of yellow, passing into hyacinth- and aurora-red — frequently very brilliant. Primary form the Regular six-sided prism, in which it likewise occurs either perfect or having the terminal edges replaced; also mammillated, reniform, and compact. The structure of the crystals is lamellar, yielding indistinctly to cleavage parallel to the planes of the prism; it is translucent, rarely transparent; external lustre of the crystal resinous; easily frangible; fracture imperfect conchoidal, or uneven. B B, on charcoal it fuses with difficulty, emits arsenical vapors, and is reduced to globules of metallic lead.

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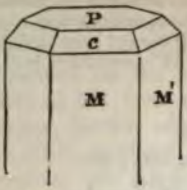
* See a paper by Dr. Thomson on the minerals found in the neighborhood of Glasgow. Lond. Edinb. and Dub. Phil. Mag., xvii. 405. 1840.



M on M'	120°	*c.g.*
P on M or M'	90	—
M on *r*	130	—

The largest crystals of this species have been found at Johanngeorgenstadt in Saxony; but at that locality they are now rare. Latterly it has occurred in beautiful translucent yellow crystals, disposed on quartz at Huel Alfred in Cornwall; and at Caldbeck Fell in Cumberland, aggregated in opake, orange-yellow, colored individuals, which consist each of three hexagonal prisms curved towards their terminations in a manner often beautifully symmetrical. The varieties from Leadhills are more remarkable for the richness of their colors than the beauty of their crystalline forms, being generally aggregated, grouped in rosettes, forming superficial coatings and otherwise indistinctly defined. The orange phosphate from this locality has been ascertained by the Rev. W. Vernon to contain about one per cent. of the chromate of lead, to which admixture he attributes the splendid tinges of that variety.—*Allan's Manual.*

Mammillated arseniate of lead occurs at Huelgoet; the reniform and orbicular varieties are met with at the Puy de Dome in Auvergne, and in the Grand Duchy of Baden; while the filamentous or capillary kind is found at St. Prix in the department of the Saone in France.

The HEDYPHAN of *Breithaupt*, described as a white, shining, massive mineral, having a specific gravity equal to 5·404, and containing, according to Kersten, oxide of lead 52·95, muriatic acid 2·03, arsenic acid 22·78, phosphoric acid 6·20, and lime 14·03—is evidently a variety of this species. It is from Langbanshyttan in Sweden.

SULPHATE OF LEAD.

ANGLESITE.

Blei Vitriol, W. Plomb Sulfaté, H. Bt. Vitriol de Plomb Natif, Br. Prismatic Lead Baryte, M. Tri-prismatic Lead-spar, J. Anglesite, *Beudant.* Cronalus Anglesea-nus, D.

Combination of sulphuric acid and protoxide of lead.

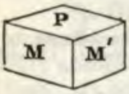
	Zellerfeld.	Anglesea.	Leadhills.
Protoxide of Lead	72·9146	71·0	74·045
Sulphuric acid	26·0914	24·8	25·655
Water	0·1242	2·0	0·800
Protoxide of iron and manganese	0·2805	1·0	0·000
	99·4107 Stromeyer.	98·8 Klaproth.	100·500 Thomson.

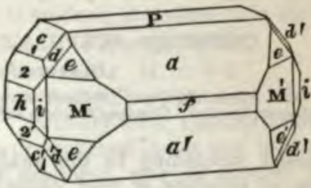
Dr. Thomson's analysis gives 5·13 atoms sulphuric acid, and 5·28 atoms protoxide of lead. The mineral when pure is therefore a simple sulphate of lead. Formula: $\underline{\mathrm{P}}\mathrm{l}\dot{\mathrm{S}}\mathrm{l}$.

Sp Gr. 6·23 — 6·31. H. = 3·0.

Color white, grey, or yellowish; frequently tinged blue or green by the oxide of copper. It occurs crystallized in rhombic prisms with dihedral terminations, but the crystals, when the prism is short, assume the general form of an octahedron; the structure is perfectly lamellar; it cleaves parallel only to the planes of a Right rhombic prism of 103° 42′ and 76° 18′, which therefore is the form of its primary crystal.

Primary.





M on M′	103°	42′	M on *h*	128°	10′
P on M or M′	90	00	—— *c*1	127	56
—— *a*	140	36	M on *i* or M′ on *i*	160	42
—— *e* or *e*	115	40	*a* on *a′*	79	30
—— *f*	90	00	*a* or *a′* on *f*	129	28
—— *h*	90	00	*c*1 on *c*1′	104	30
M on *e* or M′ on *e′*	153	20	—— *c*2	142	20
M or M′ on *f*	141	52			

When reduced to thin laminæ it is often colorless and transparent, with a splendent lustre; fracture conchoidal and resinous; brittle, and yields to the nail. It also occurs massive. B B, it decrepitates, then melts; fuses in the oxidating flame into a transparent globule, which becomes milky on hardening; and in the reducing flame effervesces, and is soon reduced to the metallic state.

The finest specimens of this species are found at the mines of Wanlockhead and Leadhills in Dumfries-shire, often in tabular-shaped crystals some inches in diameter. Pary's Mine in Anglesea, and Mellanoweth in Cornwall, are its principal English localities; while on the continent it is best known at Clausthal and Zellerfeld in the Hartz, and at Badenweiller in the Brisgau. Small but extremely perfect transparent crystals have been brought from Fondon in Granada; while the massive and compact varieties are chiefly from Siberia, Andalusia and Alston Moor.

Many of the ores of lead are unquestionably derived from the decomposition of galena, and none more distinctly so than the sulphate which is frequently met with at Leadhills, either occupying the cavities of cubical crystals, or disposed on a surface of galena, which has all the appearance of having been acted upon by acids. — *Allan's Manual.*

In the United States, very fine crystals of this mineral have been found at the Perkiomen lead mine, Penn. They are variously modified, sometimes by four-sided pyramids corresponding with the sides of the prism, the edges of these pyramids being also replaced; and a less frequent form in which they have been met with, is that of an elongated octahedron passing into the *Trihexaedre* of Haüy.

CUPREOUS SULPHATE OF LEAD.

LINARITE.

Diplogenic Lead Baryte, *Haidinger.* Schwefelsaures Blei-und-Kupfer, L. Sulfate de Plomb Cuivreux, *Beudant.* Cupreous Sulphate of Lead, *Brooke.* Chronalus rhomboideus, D.

Composed, according to the analyses of Brooke and Dr. Thomson, of sulphate of lead, oxide of copper, and water, in these proportions:

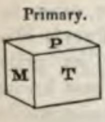
Sulphate of lead	74·4	74·8
Oxide of copper	18·0	19·7
Water	4·7	5·5
	97·1 Brooke.	100·0 Thomson.

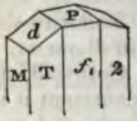
These analyses correspond with one atom sulphate of lead, one atom oxide of copper, and one atom water. Formula: $\underline{P}l\dot{S}l+\underset{.}{C}p+Aq$.

Sp. Gr. 5·3—5·4. H. = 2·5—3·0.

Of a deep azure-blue color, greatly resembling that of the brightest and more translucent varieties of blue carbonate of copper. Primary form a Right oblique-angled prism; cleavage very perfect parallel to M, less so to T; translucent; lustre vitreous or adamantine; streak pale blue.

Primary.





M on T	102°	45′
P on M or T	90	00
—— f1	90	00
T on f1	161	30
M on d	120	30
M return on f2	104	50

The above measurements are by Brooke.

It is found at the Leadhills in Scotland, and at Linares in Spain; but it is an exceedingly rare mineral.

MOLYBDATE OF LEAD.

Bleigelb, *Hausmann.* Gelb Bleierz, W. Plomb Molybdaté. H. Bt. Plomb Jaune, Br. Yellow Lead Ore. Pyramidal Lead Baryte, M. Pyramidal Lead Spar, J. Melinose, *Beudant.* Carinthite, *Brooke.* Cronalus pyramidalis, D.

It is composed of protoxide of lead and molybdic acid, according to the following analyses:

Molybdic acid	34·25	38·00	40·5	00·000
Protoxide of lead	64·42	58·00	59·0	40·293
Oxide of iron	0·00	3·00	0·0	61·903
	98·67 Klaproth.	99·00 Hatchett.	99·5 Göbel.	102·196 Melling.

The three last analyses, which nearly agree with each other, correspond with one atom molybdic acid, one atom protoxide of lead. The mean of these gives 4·40 At. molybdic acid, 4·58 At. protoxide of lead. It is evident, therefore, that the mineral is a simple molybdate of lead. Formula: $\underline{\mathrm{P}}|\dot{\mathrm{M}}\mathrm{l}$.

Sp. Gr. 6·69 — 6·76. H. = 3·0.

Color generally orange or wax-yellow, passing into grey or brown, rarely aurora-red. Primary form, the Octahedron with a square base. It occurs crystallized in flat and in acute four-sided pyramids variously modified, and in tabular crystals; structure perfectly lamellar; yields to cleavage parallel to the planes of the primary, and also to the common base of the two pyramids; fracture uneven, passing into small conchoidal, with a glistening resinous lustre; translucent, soft, and brittle. It rarely occurs massive.

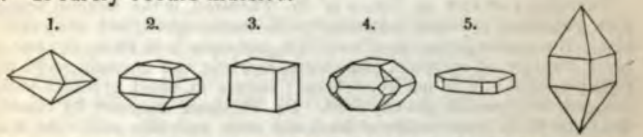
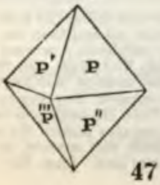
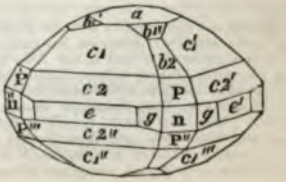


Fig. 1, an octahedron, exhibiting only the planes of c1 of the following figure, and much flatter than the primary. Fig. 2, the same of which the summits and edges of the common base of the pyramids, are replaced by planes; these planes are increased and complete in fig. 3, producing a crystal nearly in the proportions of the cube. Fig. 4, an octahedron, of which all the solid angles and the edges of the pyramids are replaced. Fig. 5, a tabular crystal arising from the deep replacement of the summits of a crystal similar to fig. 2, combined with the planes of fig. 4, which replace the lateral solid angles. Fig. 6, a quadrangular prism (fig. 3) terminated by acute pyramids.

Primary.





P on P′ or P′ on P′′′	131°	15′	*a* on *b*1	172°	7′
P on P′ or P′′ on P′′′	99	50	—— *b*2	143	24
P or P′ on *a*	114	15	*c*1 on *c*′1	128	23
P on *b*2	150	38	—— *c*1′′	76	0
a on *c*1 or *c*′1	142	10	*c*2 on *c*2′	99	30

B B, it decrepitates; on charcoal it fuses into a dark-grey mass, in which globules of reduced lead are visible; with a little borax it forms a brownish globule, and with a larger quantity a blue or greenish-blue glass. Slowly and with difficulty soluble in nitric acid, leaving a residue.

At Schwarzenbach, Bleyberg, and Windisch-Kappel in Carinthia, the molybdate of lead occurs in beds and veins of limestone, along with other ores of lead. It is also met with at Retzbanya in Hungary, and at Moldawa in the Bannat, where its crystals bear at first sight much resemblance, particularly in color, to the chromate. Crystals of the same color have more recently been brought from Siberia, by Prof. G. Rose.*

In the United States, this rare mineral has been found along with various other salts of lead, at Perkiomen, Montgomery county, Penn. According to J. P. Witherell, Esq., it occurs in rectangular four-sided tables with bevelled edges, and in low octahedrons replaced on the edges and angles. Color orange-yellow and wax-yellow. It was formerly found at the lead mine, Southampton, Mass.

TRISMOLYBDATE OF LEAD *of Dr. Thomson*, is the mineral brought from Pamplona in South America, by M. Boussingault, and analyzed by him. It contains protoxide of lead 73·8, molybdic acid 10·0; the rest being a mixture of carbonic, phosphoric, muriatic and chromic acids, with earthy matter. It is not crystallized; occurs in small greenish-yellow concretions; specific gravity 6·00. Dr. Thomson supposes its constitution to be three atoms oxide of lead, one atom molybdic acid. As it has been but imperfectly developed, it is here added only as a variety.

CHROMATE OF LEAD.

Hemi-Prismatic Lead Baryte, M. Prismatic Lead Spar, or Red Lead Spar, J. Rothbleierz, W. Kallochrom, *Hausmann.* Chromsaures Blei, *Leonhard.* Plomb Chromaté Rouge, H. Crocoise, *Beudant.* Chronalus hyacinthus, D.

Combination of chromic acid and lead.

Protoxide of lead	68·50	63·96	67·912
Chromic acid	31·50	34·40	31·725
	100·00 Berzelius.	98·36 Thenard.	99·637 Pfaff.

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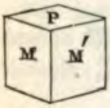
* These crystals are supposed by Prof. G. Rose to be only colored by a small portion of chromate of lead; but Prof. Johnston has analyzed this mineral from the Bannat, and finds it to be *pure chromate of lead* in the *form* of the molybdate; whence he infers the dimorphous character of that salt. — (Lond. and Edinb. Phil. Mag., xii. 387.) Prof. G. Rose has since examined the red crystals from the same locality, and has not confirmed the results obtained by Prof. Johnston, though he supposes they may contain a little chromic acid. — (Ann. des Mines, t. xvii. p. 655.) From the analogous composition of chromic and molybdic acids, and from the fact that one may replace the other without altering the crystalline form of the mineral, it is probable that some of the crystals are entirely, and others only in part, composed of chromate of lead. [AM. ED.]

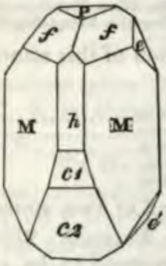
Taking Berzelius' numbers, the atoms of oxide of lead and chromic acid, are 4·89 of the former, and 4·85 of the latter thus constituting a simple chromate of lead. Formula: $\underline{P}l\dot{C}h$.

Sp. Gr. 5·95 — 6·6. H. = 2·5.

Color deep-red or hyacinth-red. Primary form an Oblique rhombic prism. Occurs in very distinct crystals; also massive. Cleavage parallel to M, perfect; translucent, sometimes only on the edges; lustre adamantine; streak orange-yellow. B B, it becomes black and decrepitates, if quickly heated; it may be fused, however, into a black slag, containing globules of metallic lead. It colors glass of borax green; and is soluble without effervescence in nitric acid, forming with it a yellow solution.

Primary.





M on M	93°	30′
P on M or M	99	10
—— *e*	119	10
—— *f*	133	0
—— *h*	102	5
M or M on *c*2	133	10
———— *f*	146	25
———— *h*	136	35
e on *f*	140	3
f on *f*	118	58

Of this rare and beautiful mineral, there are only a few known localities, the principal of which is Siberia; it occurs near Beresof, in narrow veins traversing decomposed gneiss, and associated with gold, iron-pyrites, galena, quartz, and Vauquelinite. It has also been discovered near Nische-Tagilsk, Siberia. In Brazil, at Conghonnas do Campo, it occurs in equally splendid crystals, though more sparingly, in decomposed granite.

MELANOCHROITE.*

Melanochroite, *Hermann.* (*Pogg. Ann.*, xxviii. 162.) Subsesquichromate of Lead, *Thomson.* Chronalus rubeus, D.

It contains by Hermann's analysis,

		Atoms.	
Chromic acid	23·31	3·58	1
Protoxide of lead	76·69	5·47	1·52
	100·00		

It thus appears to consist of one atom chromic acid, one and a half atom protoxide of lead; or, according to Dr. Thomson, it is a subsesquichromate of lead. Formula: $\underline{P}l^{1\frac{1}{2}}\dot{C}h$.

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* From μελανοχρος, dark color.

Sp. Gr. 5·75.

This mineral occurs, along with the preceding, at Beresof in Siberia. Its form is that of a rhombic prism, having two faces enlarged, so as to impart to it a tabular shape. Color hyacinth- or orange-red; lustre resinous; nearly opake. Very soft, slightly brittle, easily reduced to powder. B B, it does not decrepitate, but retains its shape until it fuses; and on cooling assumes a crystalline structure. Its matrix is calcareous, and it is associated with galena and Vauquelinite.

VAUQUELINITE.

Chromate of Lead and Copper. Hemi Prismatic Olive Malachite, *Haidinger*. Cupreo-chromate of Lead, *Thomson*. Cronalus Vauquelini, D.

The following is the composition of this mineral, according to Berzelius:

		Atoms.
Chromic acid	28·33	4·35
Protoxide of lead	60·87	4·35
Oxide of copper	10·80	2·14
	100·00	

It is thus evidently a compound of two atoms chromate of lead, one atom oxide of copper. Formula: $2\underline{P}l\dot{C}h+\underset{.}{C}p$. But the oxide of copper is usually supposed to be combined with chromic acid, and accordingly, Beudant has given this formula: $2\underline{P}l\dot{C}h^2+\underset{.}{C}pCh^2$ — which answers to the chemical formula of Rammelsberg; or $2Pb^3\dddot{C}r^2+\dot{C}u^3\dddot{C}r^2$.[*]

Sp. Gr. 5·8. H. = 2·5 — 3·0.

Primary form supposed to be an oblique rhombic prism. This substance occurs in mammillated masses, or minute and generally macled crystals, aggregated irregularly, and constituting a thin crust, occasionally with a tendency to the form of stalactites, which sometimes are hollow, sometimes include the chromate of lead of a dingy orange color. The crystals are black, occasionally with a tinge of green, and when viewed under the microscope, often appear splendent; or they are without lustre, and brown. Streak siskin-green or brownish. Fracture uneven; faintly translucent or opake. B B, on charcoal it intumesces slightly, and fuses into a dark-grey globule of metallic brilliancy, surrounded by small beads of reduced lead; but the globule suffers no change. Partly soluble in nitric acid.

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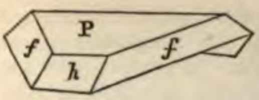
[*] This supposes the ratios of the atoms as 6 : 2 : 1, instead of 2 : 2 : 1, as above stated; the oxygen of the constituents being thus given — 13·03, 4·36, 2·18. See Beudant, Traité, ii. 670.



P on P′ over the summit	134° 30
P on *h*	149 00

It was first observed by Berzelius accompanying chromate of lead, from Beresof in Siberia. It is found also at Pont Gibaud in the Puy de Dome; and, it is said, in Brazil, along with the chromate of lead from that country.

TUNGSTATE OF LEAD.

Scheelsaures Blei, L. Plomb Tungstaté. *Levy.* Schéelitine, *Beudant.* Scheelate of Lead. Cronalus ponderosus, D.

Combination of tungstic acid and oxide of lead.

Oxide of lead	48·28	48·0
Tungstic acid	51·72	52·0
	100·00 Lampadius.	100·0 Levy.

The last analysis gives 3·40 At. oxide of lead, 3·36 At. tungstic acid. It is therefore a simple tungstate of lead. Formula: $\underline{\mathrm{Pl}}\dot{\mathrm{T}}\mathrm{n}$.

Sp. Gr. 8·1. H. = 3·0.

Primary form, according to Levy, an octahedron with a square base, P on P over the base 131° 30′. It has a single distinct cleavage parallel to its base. Occurs in aggregated, indistinctly pronounced four-sided prisms, whose terminal edges are replaced by octahedral planes. Color yellowish-grey; faintly translucent; lustre resinous; fracture conchoidal and shining. B B, it melts, and gives off vapors of lead, leaving a dark-colored metallic-like crystalline globule; when sufficiently roasted to drive off the lead, it yields, with borax, a yellow bead, which becomes transparent and deep-red on cooling; and with salt of phosphorus, at a certain degree of saturation, affords a blue one in the reducing flame.

Tungstate of lead occurs at Zinnwald in Bohemia, associated with quartz and mica. Levy mentions it as accompanying the molybdate of lead at Bleiberg in Carinthia.

VANADATE OF LEAD.

Vanadinsaures Blei, *Leonhard.* Johnstonite, *Brooke.* Chronalus Vanadicus, D.

		Zimapan.
Contains	Vanadate of lead	74·00
	Chloride of lead	25·33
	Hydrous oxide of iron	0·67
		100·00 Berzelius.

The formula given by Berzelius is: $\mathrm{Pb}\text{Є}\mathrm{l}\dot{\mathrm{P}}\mathrm{b}^2+\dot{\mathrm{P}}\mathrm{b}^3\ddot{\mathrm{V}}^2$.

	Wicklow.
Protoxide of lead	66·326
Vanadic acid	23·436
Lead	7·063
Chlorine	2·446
Peroxide of iron and silica	0·163
	99·434 R. D. Thomson.

The formula obtained from the last analysis by Dr. Thomson is: $\mathrm{PlChl}+6\underline{\mathrm{P}}\mathrm{l}^{3}\dot{\mathrm{V}}\mathrm{n}$.

Sp. Gr. 6·99 — 7·23. Scratched by the knife.

Occurs, though rarely, in indistinct hexagonal prisms, generally in globules. Primary form, according to Brooke, a Rhomboid. Color varying from straw-yellow to reddish-brown; opake, and dull. The fractured surfaces present a resinous lustre; streak white; fracture conchoidal; brittle. B B, in the forceps, it fuses, and on cooling retains its yellow color; if kept some time in fusion, however, it is changed into a steel-grey porous mass, which upon charcoal yields immediately globules of lead. *Per se* on charcoal it fuses readily, exhales the odor of arsenic, is reduced, and leaves, after heating in the inner flame, a steel-grey very fusible slag, which exhibits the re-actions of chromium. It forms green solutions with the sulphuric and muriatic acids; and a beautiful yellow solution with nitric acid.

This mineral was first noticed at Zimapan in Mexico, by Del Rio. Rose also observed it at Beresof near Ekatherineburg in Siberia, associated with phosphate of lead; and latterly it has occurred in considerable quantity among some of the old workings at Wanlockhead, in Dumfries-shire, where at first, from the resemblance it bears to that species, it was mistaken for arseniate of lead. It is there found in small globular masses sprinkled over calamine, or in thin coatings on the surface of that mineral. Isolated and perfect crystals are rare, but occasionally the larger globules exhibit traces of six-sided prisms. — *Allan's Manual.* It has also been found at the Leadhills in Scotland.

SELENITE OF LEAD.

Kersten. (*Poggendorf's Annalen*, xlvi. 277.) (*Berzelius' Rapport Annuel*, 1840, p. 117.)

This is a new mineral brought to our knowledge by the above-named chemist. It accompanies common seleniuret of lead, and it probably derives its origin from the decomposition and oxidation of that mineral.

It has a sulphur-yellow color, and appears in the form of small protuberances, which have a greasy appearance. Its fracture is fibrous; it is brittle, and presents faces of cleavage in one direction. Decrepitates, B B, without giving out any sensible quantity of water. By heating it red hot in a close tube, it melts into a dark-colored mass, and gives out selenium; at a more elevated temperature it sublimates selenic acid. Treated alone, on charcoal, it melts, is reduced to a scoria, and gives a particle of lead, surrounded by an areola of selenium. The flux indicates a trace of copper. The solution of the mineral in nitric acid resembles in every respect a solution of selenite of lead, with a trace of selenite of copper. This mineral is the first example of selenium being found in nature, in the state of an oxide. It is found in the Friederichsglück mine, near Hildbourghausen, and is sometimes mixed with oxide of copper and hydrated peroxide of iron. But a quantitive analysis of this mineral is yet wanted to complete our knowledge of this species.

GEOKRONITE.[*]

M. Svanberg. (*K. V. Acad. Handlingar*, 1839, p. 184.) (*Berzelius' Jahres Bericht*, xx. 203.)

It contains, according to Svanberg's analysis:

	Scala.	Galizien.
Lead	66·452	64·89
Copper	1·514	1·60
Iron	0·417	0·00
Zinc	0·111	0·00
Antimony	9·576	16·00
Arsenic	4·695	0·00
Sulphur	16·262	16·00
	99·027 Svanberg.	99·39 Sauvage.

The formula answering to the first analysis, by Svanberg, is thus stated:

$$5\text{PlSl}\left\{\begin{matrix}\text{Sb}^2\text{Sl}^3\\ \text{As}^2\text{Sl}^3\end{matrix}\right. \text{ or } \overset{\prime}{\text{P}}\text{b}^5\left\{\begin{matrix}\overset{\prime\prime\prime}{\text{Sb}}\\ \overset{\prime\prime\prime}{\text{As}}\end{matrix}\right.$$

This mineral was found in the silver mine of Scala in Sweden, and more recently it has been met with in the province of Galizien in Spain. It has hitherto been confounded with weissgültigerz. It is amorphous, without cleavage; its fracture being lamellar in one direction, and in the other granular and conchoidal. Its color is lead-grey, and it possesses metallic lustre. In hardness it is between mica and calcareous spar. Specific gravity 5·88. Is opake; streak similar to the color of the mineral. B B, it melts easily, exhibiting the reactions of antimony, lead and arsenic, and is finally volatilized by continued application of heat, leaving only a small residuum on the charcoal.

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[*] From γῃ, earth, and κρονος, Saturn; the symbol of which represented lead with the early chemists.

BOULANGERITE.

Sulphuret of Lead and Antimony.

This mineral was first described by Boulanger, (*An Mines, second series*, viii. 575,) and was found at Mo department of Gard, in France. Specimens from the S erentni mine at Nertschinsk, have more recently been exa by Hausmann, and analyzed by MM. Bromeis and (*Berzelius' Rapport Annuel*, 1840, p. 122.) These ar results of the analyses:

	Moliéres.		Nertschinsk.	
Lead	53·9		53·87	56·288
Antimony	25·5		23·66	25·037
Sulphur	18·5		19 11	18·215
Iron	1·2		1·78	0·000
Copper	0·9	Silver.	0·05	0·000
	100·0 Boulanger.		98·47 Bruel.	99·540 Bromeis.

The formula stated by Rammelsberg, and with the re numbers of which the last analysis very nearly agrees, $\overset{\prime}{\dot{\mathrm{P}}}\mathrm{b}^{3}\overset{\prime\prime\prime}{\mathrm{S}}\mathrm{b}$.

Sp. Gr. = 5·97. Hardness not stated.

Color bluish-grey. Lustre metallic. Occurs in m which exhibit on fracture a crystalline structure. I described as presenting a distinct crystallization. B readily fuses, giving out sulphurous acid and fumes of oxide of antimony; on charcoal it shows the presence o Is easily attacked by nitric acid, and boiling muriati decomposes it with the extrication of sulphuretted hydro

KOBELLITE.*

M. Setterberg. (*K. V. Acad. Handlingar*, 1839, p. 188.) (*Berz. Rap. Ann.*, 1840

This is a new mineral species found in the cobalt mi Hvena in Sweden. Its analysis gave M. Setterberg th lowing constituents:

Sulphuret of lead	46·36
Sulphuret of antimony	12·70
Sulphuret of bismuth	33·18
Sulphuret of iron	4·72
Sulphuret of copper	1·08
Guange	1·45
	99·49

These results correspond with the formula: 3FeSl,2S +12PlSl,BsSl; or $\overset{\prime}{\dot{\mathrm{F}}}\mathrm{e}^{3}\overset{\prime\prime\prime}{\mathrm{S}}\mathrm{b}^{2}+12\overset{\prime}{\dot{\mathrm{P}}}\mathrm{b}\overset{\prime}{\dot{\mathrm{B}}}\mathrm{i}$.

Sp. Gr. 6·29 — 6 32. Hardness not stated.

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* In honor of M. Von Kobell, to whom mineralogy is much indebted.

It has the appearance of sulphuret of antimony, but is more brilliant. It possesses a radiated crystalline structure. Streak and powder black. It dissolves in chlorhydric acid with the evolution of sulphydric acid gas. Exposed B B, it melts and produces a yellow deposit on the charcoal; the greater part volatilizes, a small metallic globule only remaining. No further description has been given, and we are without any knowledge of its crystalline form.

SULPHURET OF ZINC.

Blende,* W. Zinc Sulfuré, H. Bt. Dodecahedral Garnet Blende, M. Dodecahedral Zinc Blende, J. Zincum sterile, *Linn.* Black Jack. Acarpia dodecahedra, D.

The sulphuret of zinc, mixed with variable proportions of the proto-sulphuret of iron; in some varieties also from two to three per cent. of proto-sulphuret of cadmium.

	England.	Pyrenees.	Locality not given.
Zinc	61·5	63·0	66·34
Sulphur	33·0	33·6	33·66
Iron	4·0	3·4	0·00
Gangue	1·5	0·0	0·00
	100·0 Berthier.	100·0 Berthier.	100·00 Arfvedson.

	Localities not given.		Ancram, N. Y.
Zinc	66·00	66·63	61·64
Sulphur	32·63	32·63	33·56
Iron	1·37	0·74	4·30
Gangue	0·00	0·00	0·50
	100·00 Thomson.	100·00 Thomson.	100·00 Beck.†

It is evident that the mineral, when pure, is composed of one atom zinc and one atom sulphur, or is a simple sulphuret; requiring, according to Berzelius, 66·72 of zinc, and 33·28 of sulphur. Formula: ZSl or $\acute{Zn}$.

Sp. Gr. 4·0 — 4·2. H. = 3·5 — 4·0.

Color brown, yellow, blackish-brown, red, and black, rarely green. Primary form the Rhombic dodecahedron. It occurs crystallized and amorphous; the forms of its crystals are very numerous; structure perfectly lamellar, and mechanically divisible with facility into the dodecahedron, octahedron, obtuse rhomboid, acute rhomboid, and irregular tetrahedron; the lustre of the fragments is splendent, sometimes adamantine; it is translucent or opake, yields to the knife, is moderately brittle, and easily frangible in the direction of the laminæ. Streak varying with the color, from white to reddish-brown. When strongly heated in the oxidating flame of the blowpipe, it emits vapors of zinc, which deposit on the charcoal; but it is infusible, even with the addition of borax. It gives out an hepatic odor when pulverized and digested in sulphuric acid. Some varieties are highly phosphorescent when rubbed or struck with the steel.

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* From the German, signifying *glistening*; in allusion to its shining crystals.

† Mineralogy of New York, p. 408.

Though the forms and colors of blende are extremely various, the perfect cleavage which it presents parallel to the faces of the dodecahedron is highly characteristic. It may be distinguished also from those varieties of galena, garnet, and tin, which it occasionally resembles, by the facility with which it yields to the knife.

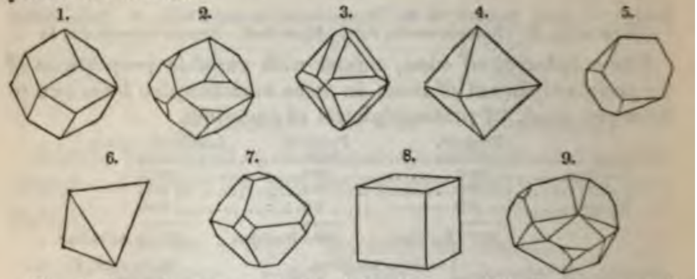
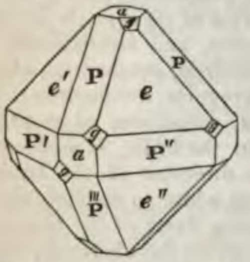


Fig. 1, the primary; a rhombic dodecahedron. Fig. 2, the same, of which eight of the solid angles are replaced by as many triangular planes; which, in fig. 3, are increased greatly, forming the passage of the rhombic dodecahedron into the regular octahedron, fig. 4. Fig. 5 is an octahedron, which has received an increase of crystalline laminæ progressively diminishing in size, on opposite faces; this crystal forms the passage of the octahedron into the tetrahedron, fig. 6, in which the triangular planes of fig. 5 have received a still further increase of laminæ. Fig. 7, a regular octahedron, of which the six solid angles are replaced by quadrangular planes, which are increased and complete in fig. 8, the cube. Fig. 9, a crystal in the general form of the rhombic dodecahedron (fig. 1), but modified in part with the small equilateral triangular planes of fig. 2, and of which the edges are alternately replaced by isosceles triangular planes inclining on the solid angles.



P on P' or P''	120°	00′	00″	H.
P, P', or P'' on a . . .	135	00	00	—
P on e, or e'	144	44	08	—
a on e, e', or e''	125	15	52	—
e on e' or e''	109	28	16	—
e' on e'' over a	70	31	44	—
g on g over a	129	31	18	—

Blende (the *black-jack* of English miners) is a mineral of very frequent occurrence, being met with in beds and veins accompanying most of the ores of silver and lead. It is found not only crystallized as above, and in macles, but massive, fibrous, and botryoidal. The dark-colored crystalline varieties are principally from Derbyshire, Cumberland, and Cornwall, though many splendid specimens are also brought from Transylvania, Hungary, and the Hartz. A transparent bright-yellow variety accompanies Bournonite and fahlerz at Kapnik; a still more brilliant one of an oil-green color occurs at Schemnitz; while Sahla in Sweden, Ratieborzitz in Bohemia, and several of the Saxon localities, are celebrated for the splendid brown and black crystals which they afford. — *Allan's Manual.*

Very large and beautiful crystals have been brought from the Silver mines of Peru and Chili. A specimen of remarkable richness, in transparent dodecahedrons, of an oil-green color, is in the cabinet of Dr. Martin Gay.

This ore is abundant at several places in the United States, and usually accompanying galena, as at Perkiomen, Penn., Eaton, N. H., St. Lawrence county, N. Y., Lubec, Me., Southampton, Mass., Middletown, Conn., and among the lead mines of Missouri and Wisconsin. It rarely occurs in distinct crystals at these localities, but remarkably brilliant and perfect crystals, of a fine honey or wax-yellow color, and nearly transparent, are frequently met with in the limestone at Lockport, and on Goat Island, near Niagara Falls. They are in the form of figs. 1 and 4, and also present various modifications of these forms. Prof. Beck found very perfect tetrahedrons (fig. 6) sometimes having their solid angles replaced by tangent planes, as shown in fig. 5; these are from Sullivan county, N. Y. The black blende of Shelburne and Warren, N. H., according to Dr. Jackson, sometimes occurs in tetrahedra and octahedra, but it usually presents large foliated masses of a crystalline structure, readily cleaving into rhombic dodecahedrons. At the former place, it is associated with argentiferous galena, iron and copper pyrites; at the latter, it forms veins in tremolite, and is supposed to be abundant. Dr. Jackson found in it three per cent. of cadmium.

Though this ore is frequently found in large quantities, the difficulty of reducing it, and the limited extent to which it can consequently be applied, render it a production of little importance; it is however, in some instances, employed as an ore of zinc. According to De la Beche, it was not considered worth raising in Cornwall, in 1839, though it is one of the most abundant ores that occur there. It is abundantly associated with the ores of copper and with lead, but more rarely with oxide of tin. *Ordnance Survey of Cornwall, Devon, &c.*

Cadmiferous Blende. — The splendent fibrous blende of Przibram possesses a lustre very nearly metallic, especially after fresh fracture; its structure is radiated, the fibres are shining, and of a brown color, and it contains a small proportion of cadmium. It has been examined by Lowe, who found it to contain two per cent. sulphuret of cadmium, three and two-thirds per cent. sulphuret of iron, and ninety-four and one-third per cent. of sulphuret of zinc.* A white fibrous variety in botryoidal concretions also occurs in Fowey consolidated mines; the massive in many other Cornish localities, and in the United States.

VOLTZITE.

M. Fournet. (*Poggendorf's Annalen*, xxxi. 62.) Oxysulphuret of Zinc.

This mineral occurs at Rosiers, near Point Gibaud, Dept. Puy de Dome, and is thus constituted, according to the analysis of M. Fournet:

Sulphuret of zinc	82·92
Oxide of zinc	15·34
Oxide of iron	1·84
	100·10

These numbers approach very nearly five atoms sulphuret of zinc, to one atom oxide of zinc. Formula: $5ZSl+\underset{\cdot}{Z}$.

Sp. Gr. 4·5. H. = 3·66.

Its color is yellowish-red, interspersed with brown streaks; lustre pearly, in some directions vitreous or resinous; opake or feebly translucent. It is not crystallized, but presents the form of hemispherical masses, which are divisible in very thin layers, and have a conchoidal or irregular fracture. Soluble in hydrochloric acid, with the disengagement of sulphydric acid gas. It has been named in honor of M. Voltz, engineer in chief of mines.

RIOLITE.

Seleniet of Zinc. Seleniet of Zinc and Mercury. Riolite, *Brooke.* Rionite, *Shepard.* Zincites flammans, D.

Its constituents, according to the analysis of Del Rio, are thus stated:

Selenium	49·
Zinc	24·0
Mercury	19·0
Sulphur	1·5
Lime	6·0
	99·5

The sulphur is supposed to be accidental, and, according to Berzelius, the formula may be thus stated: $2Z^2Sel^3+HSel$.

Sp. Gr. 5·56. H. not stated.

It has a lead-grey color; lustre metallic; opake. Occurs massive, and has a granular structure. B B, it burns with a fine violet-colored flame, and exhales selenium with the strong odor of horse-radish. When heated in a retort, selenium, mercury, and a little sulphur sublime, and there remains oxide of zinc easily soluble in acids.

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* Berzelius' Rapport Annuel, 1837, p. 192.

This mineral was found by Del Rio, at Calebras, in the mining district of El Doctor, Mexico, and has been named in honor of its discoverer.

RED OXIDE OF ZINC.

STERLINGITE.

Manganesian Oxide of Zinc, *Thomson*. Prismatic Zinc Ore, M. Zink Oxyd, L. Zinc Oxydé Manganesifère, B. Red Zinc, or Red Oxide of Zinc, J. Rutilus Brucii, D.

Combination of oxide of zinc and oxide of manganese. Dr. Bruce discovered iron, but he does not state the proportion, and it was probably owing to the impurity of the specimen. The analysis by Berthier, shows it to consist of seven atoms oxide of zinc, and one atom sesquioxide of manganese.

	New Jersey.		New Jersey.	Atoms.	
Oxide of zinc	92·0		82·0	16·58	6·9
Oxide of iron and manganese	8·0	Sesqui-oxide of manganese	12·0	2·4	1
	100·0 Bruce.		100·0 Berthier.		

The constitution of the mineral is thus shown to be seven atoms oxide of zinc, one atom sesquioxide of manganese. Formula: $\underset{\cdot}{Z}^7\underset{\cdot}{M}n$.

Sp. Gr. 5·4 — 5·5. H. = 4·0 — 4·5.

Color aurora- or vermilion-red, inclining to yellow. Primary form a Right rhombic prism of about 125° and 55°. It occurs massive, disseminated, and micaceous, but never in distinct crystals; the structure is lamellar; principal cleavage parallel to the terminal plane of the prism; translucent when reduced to thin laminæ, or opake; with an adamantine or shining lustre; but on exposure it becomes dull and covered by a pearly crust; streak orange-yellow; fracture conchoidal; brittle, and easily scratched by the knife. It is infusible B B, without addition, covering the charcoal with zinc fumes when exposed to the reducing flame; but with borax melts into a transparent yellow bead, and with salt of phosphorous forms a colorless one. It is soluble without effervescence in nitric acid, and is supposed to derive its red color from the manganese it contains. In crucibles at a white heat in contact with charcoal, the oxygen is taken up, and the zinc volatilizes, and may be collected in the ordinary way, much purer than that usually obtained from the sulphuret by distillation.

This mineral is known to occur only in Sussex county, N. J., where it forms an extensive bed in limestone, accompanied by Franklinite, Troostite, &c. It is scattered in small qu tities through various parts of the valley of Sparta, but Franklin and Sterling, particularly the latter, the great workable quantities exist to invite the attention of capitalis It is probably the richest deposit of zinc ore of which we ha any knowledge.

Mitscherlich has described some minute six-sided prism formed artificially in the iron furnaces of Konigshütte Silesia, which he believes to belong to this species.

SILICEOUS OXIDE OF ZINC.

Electric Calamine. Prismatic Zinc Baryte, M. Prismatic Calamine, J. Galmei (in par W. Zinc Oxydé Silicifère, H. Hydrous Silicate of Zinc, *Dr. Thomson.* Zincal peritomus, D.

Combination of oxide of zinc, silica, and water.

	Limbourg.	Altenberg.	Brisgau.	Leadhills.
Oxide of zinc	66·83	66·37	64·5	66·8
Silica	24·89	26·23	25·5	23·2
Water	7·46	7·40	10·0	10·8
	99·19 Berzelius.	100·00 Berzelius.	100·0 Berthier.	100·8 Thomso

It consists, according to these analyses, of one At. sili one At. oxide of zinc, one At. water. The water is rathe less than one atom, but Dr. Thomson supposes that the de ficiency is in consequence of the mineral having undergone kind of efflorescence.* Formula: $ZS+Aq$.

Sp. Gr. 3·3—3·6. H.=5·0.

Most prevalent color white, occasionally blue, green, yellow or brown. Primary form a Right rhombic prism. It occur crystallized, stalactitic, mammillated, botryoidal, and massive The crystalline forms are numerous; the crystals are mostl disposed in radiated groups; cleavage perfect parallel to M fracture uneven; streak white; lustre vitreous; varies from transparent to opake; yields to the knife, but is much harde than the carbonate of zinc. When gently heated it is strongl electric; some varieties become so by friction. B B, it slightl decrepitates, loses its transparency, intumesces, and emits green phosphorescent light; it is infusible without addition but is soluble with borax into a clear glassy globule, whic becomes opake on cooling. Reduced to powder it dissolves i heated sulphuric and muriatic acid, and the solution gelatinize on cooling.

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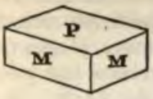
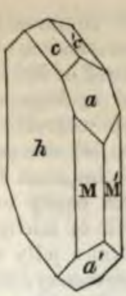
[*] See a paper by Dr. Thomson on the minerals found in the neighborhood of Glasgo Lond. Edinb. and Dub. Phil. Mag. xvii. 406, 1840.

Primary.





M on M′	108° 40′
M or M′ on *a*	132 35
M on *h*	128 40
a on *c* or *c*′	115 00
c on *c*′	126 36

This species and the following, are frequently found associated in veins, with blende, iron and lead. Considerable quantities occur at Bleiberg and Raibel in Carinthia, often in extremely delicate crystals. Several beautiful varieties are met with near Freiburg in the Brisgau, at Retzbanya in Hungary, Tarnowitz in Silesia, and Altenberg near Aix-la-Chapelle. Concentric botryoidal groups occur in the Mendip Hills, and at Wanlockhead in Dumfries-shire; and numerous pseudomorphic crystals, assuming different forms of the carbonate of lime, are found in Derbyshire, and at Schemnitz in Hungary.

According to Prof. Wm. B. Rogers, electric calamine is very abundant in the lead mines of Weythe county, Virginia, both massive and in groups of small radiating crystals.

CARBONATE OF ZINC.

Galmei (in part), W. Zinc Carbonaté, H. Calamine.* Rhombohedral Zinc Baryte, M. Zinc Spath, L. Rhombohedral Calamine, J. Smithsonite, *Beudant.* Anhydrous Carbonate of Zinc, *Thomson.* Zincalus rhombohedrus, D.

Its constituents are carbonic acid and oxide of zinc, as here shown:

	Somerset.	Derby.	Altai.
Oxide of zinc	64·8	65·2	62·5
Carbonic acid	35·2	34·8	36·0
	100·0 Smithson.	100·0 Smithson.	98·5 John.

There is a considerable loss in the last specimen, but there is a near agreement in the atoms deduced from the two first analyses: in the second, oxide of zinc 12·44 At., carbonic acid 12·29 At. It is evident, therefore, that the mineral is a simple carbonate of zinc. Formula: $\dot{Z}\dot{C}$.

Sp. Gr. 4·2—4·5. H. = 5·0.

Calamine is found crystallized, compact, pseudomorphic,

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* From the Latin, *calamus*, a reed; when in fusion, it adheres to the base of the furnace, in the form of reeds.

earthy, and cupriferous. Color commonly greyish or ye
ish, but also occurs of various shades of green and br
Primary form an Obtuse rhomboid of 107° 40′. It is fou
obtuse and acute rhombs, and in long quadrilateral t
which sometimes are modified; structure perfectly lam
yielding to cleavage parallel to all the primary planes;
external lustre of the crystals is between vitreous and pe
translucent or opake, and yields easily to the knife. I
solves with effervescence in nitric or muriatic acid, but it
not, like the silicate of zinc, form a jelly with them. B
is infusible, but loses its transparency, the carbonic ac
driven off, and the residue acts like pure oxide of zinc.
salt of phosphorus it fuses into a transparent glass, whic
comes, in the reducing jet, clouded on flaming, and for
white enamel when cold. It is negatively electrified by fric

Most of the localities of the foregoing species are also
mon to this. A dark-brown colored variety, and another
beautiful bright green, are found in Siberia. Dognatzka
the Bannat in Hungary; Reibel and Bleiberg in Carint
Tarnowitz in Silesia; Aix-la-Chapelle; Mendip in Some
shire; Matlock in Derbyshire; Wanlockhead and the
Hills in Scotland; all produce it in considerable abunda
It is a very rare ore in the mining districts of Cornwall
Devon, but one or two mines of it are still in work. A
pact, fibrous, semi-transparent variety, of a pale-yellow c
disposed in concentric laminæ, also occurs at Alston Moo
Cumberland.

In a paper by J. P. Witherell, Esq., (*Jour. Acad. Nat.*
Philad., v. 314,) this mineral is described as occurring at
Perkiomen lead mine in globular and reniform masses,
pale-blue or brown color, and possessing a radiated struct
At Brookfield, Conn., it occurs in limestone, in the form o
impalpable powder, accompanying blende and galena.
Houghton has also detected it in the copper region of Mi
gan. At the zinc mines, both at Franklin and Sterling, N
carbonate of zinc forms thin incrustations upon the lamin
the red oxide, as well as upon Franklinite. It seems to f
constantly by the decomposition of the ore, and the absorb
of carbonic acid from the atmosphere.

This species, however, does not so often occur crystallize
the siliceous oxide, being more generally stalactitic, renifo
mammillated, cellular, and amorphous; sometimes imperfe
fibrous; and frequently assuming the aspect of calcedony.

HYDROUS DICARBONATE OF ZINC.

The difference between this mineral and the preceding, was pointed out by Smithson, in *Nicholson's Journal*, vi. 76. It accompanies the anhydrous carbonate, but has never been found in crystals. Mr. Smithson obtained the following constituents, from a specimen from Bleyberg:

Carbonic acid	13·52
Oxide of zinc	69·36
Water	15·10
	97·98

These numbers, as viewed by Dr. Thomson, give very nearly one atom carbonic acid, two atoms oxide of zinc, two atoms water; and therefore constitute a hydrous dicarbonate of zinc. Formula: $\underset{\cdot}{Z}^2\dot{C}+2Aq$.

Sp. Gr. 3·584—3·598. H. = 2—2·5.

Does not phosphoresce when scraped. When plunged into water it absorbs about one-third of its weight of that liquid. B B, it becomes yellow, but recovers its color on cooling. Before the reducing flame it is entirely dissipated, abundance of flowers of zinc being deposited on the charcoal. With borax and biphosphate of soda it fuses with effervescence into a clear colorless glass, which becomes opake on cooling, if over saturated. Carbonate of soda has no action on it.

AURICHALCITE.*

M. Böttger. (*Poggendorf's Annalen*, xxxviii. 495.)

This mineral, from Loktewsk in Altai, analyzed by the above named chemist, gave the following constituents:

Oxide of copper	28·19
Oxide of zinc	45·84
Carbonic acid	16·06
Water	9·93
	100·02

$$\text{Formula: } 2\left.\begin{matrix}\dot{\mathrm{Cu}}^2\\ \dot{\mathrm{Zn}}^2\end{matrix}\right\}\ddot{\mathrm{C}}+\left.\begin{matrix}\dot{\mathrm{Cu}}\\ \dot{\mathrm{Zn}}\end{matrix}\right\}\dot{\text{Ħ}}^3.$$

It occurs amorphous, sometimes granular, and at other times in radiating masses of a green color, slightly transparent and of little hardness. In the alembic it gives out water, and becomes black; on charcoal, exposed to the inner flame, it is reduced to a zinc slag, and with fluxes shows the reaction of copper. With soda and borax it is reduced to a globule of copper.

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* Thus named, because it contains the elements of laiton aurichalcum.

Berzelius observes that this mineral differs not essentially from the green cupreous calamine of M. Patrin, which occurs near Kleopinski, in drusses, in a carbonate of zinc, very rich in cadmium. He supposes it to contain more carbonate of copper; and the green calamine of M. Patrin is crystallized, and has a pearly lustre.*

WILLELMINE.

Willelmine, *Levy* and *Beudant*. Willemit, *Leonhard*. Zincalus acrotomus, D.

A specimen analyzed by Dr. Thomson gave the following constituents:

		Atoms.
Oxide of zinc	68·77	13 09
Silica	26·97	13·48
Peroxide of iron	1·48	
Alumina, zinc and iron	1·44	
Water	1·25	
	99·91	

A specimen, which seems to have been purer, was analyzed by M. Levy, who obtained results that approach nearer to one atom oxide of zinc, and one atom silica, viz. of $\underset{\cdot}{Z}$ — 72·38, of S — 27·67, in 100 parts: equal to 13·79 At. of the former, and 13·83 At. of the latter. It is evident, therefore, that the mineral is a simple anhydrous silicate of zinc. Formula: $\underset{\cdot}{Z}S$.

Sp. Gr. 4·18. H. = 5 — 5·5.

Crystallized in regular six-sided prisms, terminated by rhombic faces inclined to one another at an angle of about 128°. Primary form an Obtuse rhomboid of 128°. Color white, yellow, red, or reddish-brown. The crystals vary from transparent to translucent. Cleavable in one direction, perpendicular to the axis. B B, it decrepitates, coloring the flame green, but does not fuse. Forms a jelly in nitric or muriatic acid.

It occurs in the calamine deposits of the Vielle Montagne, near Aix-la-Chapelle.

A silicate of zinc from Franklin, N. J., analyzed by Vanuxem and Keating, agrees very nearly in composition with the species above described. They obtained oxide of zinc 71·33, silica 25·00, oxide of manganese 2·66, peroxide of iron 0·67.

SULPHATE OF ZINC.

Prismatic Vitriol Salt, M. Pyramidal Vitriol, J. Gallizinite, *Beudant*. Zink Vitriol, *Karsten*. Zinc Sulphatê, H. White Vitriol, A. Vitriolum Zincicum, D.

It is a hydrous sulphate of zinc.

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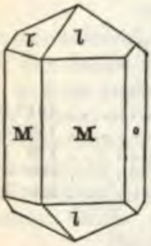
* Rapport Annuel for 1840, p. 135.

	Schemnitz.	Rammelsberg.
Oxide of zinc	28·5	27·5
Sulphuric acid	29·8	22·7
Oxide of manganese	0·7	0·5
Oxide of iron	0·4	0·0
Water	40·8	49·3
	100·2 Beudant.	100·0 Klaproth.

Beudant's formula, deduced from his own analyses, is: $Z\dot{S}l^3+6Aq$.

Sp. Gr. 2·036. H. = 2·0 — 2·5.

Greyish-, yellowish, reddish-, or greenish-white. Primary form a Right rhombic prism of 90° 42′.* It seldom occurs distinctly crystallized, generally massive, stalactitic, botryoidal, reniform, and investing; cleavage perfect parallel to the face *o;* fracture conchoidal; lustre vitreous; streak white; transparent or translucent; with a nauseous metallic taste. B B, it is fusible with ebullition, giving off its sulphuric acid, and covering the charcoal with a white coating. It is readily soluble in water.



M on *l*	129° 2′
M on M	90 42

It occurs principally in the deserted galleries of old mines, frequently with blende, and is supposed to arise from the decomposition of that mineral. It is found at Rammelsberg near Goslar, in the Hartz, in Austria, Hungary, at Fahlun in Sweden, and at Holywell in Flintshire; but it is a rare species.

HOPEITE.†

Brewster. (*Trans. Royal Soc. Edin.*, x. 107.)

"A compound of some of the stronger acids, — as phosphoric or boracic — zinc, an earthy base, a little cadmium, and a great deal of water." But no complete analysis has been published.

Sp. Gr. 2·46 — 2·76. H. = 2·5 — 3·0.

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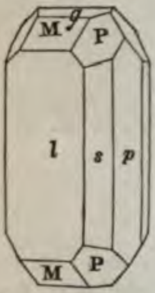
[*] 91° 7′ and 88° 53′ according to Beudant. Traité, ii. 480.

[†] In honor of Dr. Hope, Regius Professor of Chemistry in the University of Edinburgh.

Primary a Right rhombic prism M on M′ = 1
Cleavage perfect parallel to *l*. Color greyish-white ;
rent or translucent; lustre vitreous, inclining to pearly
face *e*; streak white. Surface of *p* deeply striated lo
nally; rest of the faces smooth. Entirely soluble
effervescence in the muriatic and nitric acids, but i
upon very slowly by sulphuric. Neither phosphoresc
electric by heat. Yields water in the matrass, and mel
into a clear colorless globule, which tinges the flame g

With carbonate of soda it gives a scoria, wh
is of a yellowish color. The oxide of zinc condenses r
in great quantity on the charcoal, and next the scoria is
dish-yellow tint, which does not vanish on cooling, an
cates the presence of cadmium. A solution of cobalt c
nicates a fine bluish tint to the melted assay. From t
racters above stated, Hopeite is probably a phosphate o
containing cadmium; but it has not yet been subjecte
analysis.



M on M over *g*	101° 2
M on *g*	140 42
M on *l*	129 1
l on *s*	130 47
P on *s*	139 13

This is a very rare substance; it was noticed by Sir
Brewster; and has hitherto been found only in the ca
mines of Altenberg, near Aix-la-Chapelle.

MARMATITE.

M. Boussingault. (*Ann. de Chim. et de Phys.*, xliii. 312.)

This mineral is composed of sulphuret of zinc and sul
of iron, and the analyses of two specimens by the above-
chemist, gave the proportions as follow :

			Atoms.
Sulphuret of zinc.......	77·5............	76·8............	12·48
Sulphuret of iron.......	22·5............	23·2............	4·22
	100·0	100·0	

The atoms of the former are to those of the latter co ent, nearly as three to one; consequently, the formula for this mineral is thus expressed: $FSl+3ZSl$; or $\overset{\prime}{F}e+3\overset{\prime}{Z}n$.

It occurs in black foliated masses, and very much resembles blende in many of its characters, whence it has been called the "blende of Marmato." It probably offers an example, more common than is generally supposed, of sulphuret of zinc and sulphuret of iron chemically combined. According to Von Kobell, it is readily soluble in muriatic acid, giving out sulphydric acid gas. No sulphur is set free. With excess of ammonia, an abundant precipitate of protoxide of iron is thrown down. Pure zinc blende gives a precipitate with ammonia, which is either entirely soluble in excess, or leaves behind only a few red flocks of oxide of iron; Marmatite is also more easily decomposed by muriatic acid. It occurs at Marmato in the province of Popayan, Columbia.

SULPHURET OF CADMIUM.

Greenockite of *Prof. Jameson.*

This rare mineral, formerly supposed to be simple sulphuret of zinc, was shown by Lord Greenock to be a different substance, and on analysis by Mr. Connell of Edinburgh, it was found to consist of 22·56 sulphur, 77·30 cadmium, and therefore, to constitute a new species. Nearly the same results have been obtained by Dr. Thomson, viz. sulphur 22·4, cadmium 77·6.* It evidently consists of one atom of each of its elements.

Formula: $CdSl$.

Sp. Gr. 4·842. H. = 2·75.

Translucent to transparent. Lustre vitreous, sometimes almost adamantine. It is always crystallized in six-sided pyramids, the summits being sometimes replaced by a more acute pyramid. Some of the crystals are regular six-sided prisms.

It occurs with prehnite in an amygdaloidal rock at Bishoptown, in Renfrewshire, and also, according to Dr. Thomson, on the Cochno burn, on the north side of the Clyde. It was named by Prof. Jameson in honor of Lord Greenock, whose examination of it ultimately led to a true knowledge of its character.

NATIVE QUICKSILVER.

Mercury. Gediegen Quecksilber, W. Mercure Natif, H. Bt. Liquid Mercury, M. and J. Hydrargyum. Argentum Vivum. Spuma argenti. Liquor Æternalis, *Pliny*. Hydrargyrum fluidum, D.

Fluid mercury is the pure metal as produced by nature; it presents no determinate form, but occurs in small globules disseminated through its matrix.

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* Lond. Edin. and Dub. Phil. Mag., xvii. 418, 1840.

It is of a silver-white color, with a splendent metallic lustre Specific gravity 13·6. It volatilizes entirely B B, at less tha a red heat; becomes solid at a temperature of — 40°; and i easily soluble in nitric acid.

It occurs in most of the mines producing the ores of quicksilver, particularly those of Idria in Carniola, Almaden i Spain, and the Palatinate. At Idria it is found in a kind o slate-clay, which forms the upper portion of the mines; and from this source is obtained by means of washing. Near Limach, and at Guancavella, in Peru, it is found with the sulphuret. Mercury is used in various chemical and pharmaceutical preparations; in the amalgamation of gold and silver ores for which purpose vast quantities are annually exported fro Europe to the South American continent; in the formation o artificial cinnabar, and fulminating powder for percussio guns; in silvering mirrors; making thermometers and barometers; and for many other purposes.

The quantity of native quicksilver annually obtained fro the Almaden mines, is about twenty-two thousand quintals two-thirds of which is consumed at the Mexican mines in amalgamation. In consequence of the high price demanded for i many of the Mexican silver mines have been abandoned, an great hopes are entertained that some other material or proces may be found as a substitute. Since 1828, the price has raise from $60 to $130 per quintal.

NATIVE AMALGAM.

Naturlisches Amalgam, W. Mercure Argental, H. Bt. Dodecahedral Mercury. M. and
Amalgame, *Necker*. Amalgam, *Haus.* and *L.* Hydrargirum dodecahedrum, D.

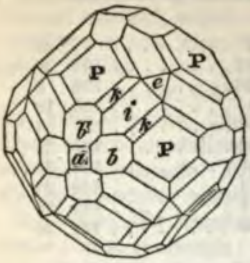
Union of mercury and silver.

Mercury	64·0	72·5
Silver	36·0	27·5
	100·0 Klaproth.	100·0 Cordier.

The specimen analyzed by Klaproth, consists of two atom mercury to one atom silver; while Cordier's numbers giv three of the former to one of the latter. It would seem, therefore, supposing both analyses correct, that they constitute tw distinct species. Formula: H^2Ag or H^3Ag.

Sp. Gr. 10·0 — 14·1. H. = 1·0 — 3·5.

Silver-white, or greyish. Primary form, a Rhombic dodecahedron. It occurs in a semi-fluid state; also massive; an occasionally forms large and very perfect crystals, with numerous modifications of the rhombic dodecahedron; but no dis tinct cleavage has been observed; has a flat conchoidal fracture; is soft, cracks when cut, and acquires vitreous electricity from friction when isolated. B B, the mercury is volatilized, and a bead of silver remains. It whitens the surface of copper when rubbed warm upon it. Soluble in nitric acid.



P or P on P	120°	2′
P on *a*	135	00
—— *b*	154	00
—— *i*	150	00
—— *k*	160	40
a on *b*	161	2
i on *k*	169	5

It is found principally at Rosenau in Hungary, and at Moschellandsberg in Deux Ponts, accompanied by quicksilver and cinnabar, in ferruginous and argillaceous veins, and is described as occurring at those points where veins of silver and mercury traverse one another.

SULPHURET OF MERCURY.

Peritomous Ruby Blende, M. Prismato rhomboidal Ruby-blende, J. Quecksilber-Lebererz. Zinnober, W. Mercure Sulfuré, H. Bt. Cinnabar, A.* Minium. Rubella peritoma, D.

Combination of mercury and sulphur.

	Japan.	Idria.
Mercury	84·50	85·00
Sulphur	14·75	14·25
	99·25 Klaproth.	99·25 Klaproth.

Klaproth appears to be the only chemist who has analyzed this mineral. His results, divided by the atomic weights, indicate one atom of each of the elements, or a simple sulphuret of mercury. Formula: H Sl.

Sp. Gr. 6·7—8·2. H. = 2·0—2·5.

It varies in color from carmine, through cochineal-red, to lead-grey; in this last case it is opake, and has a metallic lustre; when it is red it is more or less translucent, and exhibits an adamantine lustre. Primary form an Acute rhomboid of 71° 48′ and 108° 12′, in which it also occurs crystallized; but the crystals are mostly modified by secondary planes; also massive, fibrous, and pulverulent. Structure lamellar, in tl massive sometimes curved, with a shining lustre; cleava highly perfect parallel to P, the primary rhomboid; strea bright scarlet. B B, it melts, and is volatilized with a bl flame and sulphurous odor. On being sublimated it crysta lizes in columnar masses. It is soluble in nitro-muriatic aci

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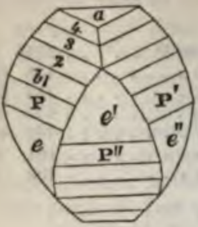
* From the Greek, signifying a red-colored grain.



P on P′	71°	48′
P on b2	157	20
—— b3	152	8
—— e	159	18
a on b1	127	5
—— b2	133	22
—— b3	138	34
—— b4	146	31
e on b1	142	55
—— b3	131	26

Figure and measurements on the authority of Haüy.

The *Lebererz* or *Hepatic Cinnabar* is dark-red, sometime nearly iron-grey; it occurs both compact and slaty; and, be ing generally mixed with impurities, such as bituminous mat ter or clay, affords a brownish streak, and is always opake.

The best-defined crystals of cinnabar are found in the co formation of Moschellandsberg and Wolfstein, in the Palati nate, though it also occurs in beds traversing gneiss at Reich enau, in Upper Carinthia, in grauwacke at Dumbrawa i Transylvania, and in limestone at Neumarktel in Carniol Well-crystallized specimens are mentioned also from Japar Mexico, and Brazil. The principal repositories of this or however, are Almaden in Spain, and Idria in Carniola, wher it occurs almost exclusively massive, and whence it is obtaine in large quantities as an ore of mercury. The variety terme *coralinerz*, from the latter locality, consists of curved lamell concretions, which present the form and apparent structure fossilized shells.

Cinnabar is the most abundant and most important ore mercury, which is obtained from it in a metallic state by sul limation. Vermilion is, in fact, pure cinnabar, being a com pound of mercury and sulphur, in nearly the same proportion as in this species. — *Allan's Manual.* In Peru sulphuret mercury was observed by Mr. Blake in connection with mag netic iron, iron pyrites and galena, at Guancavellica — th only place in South America where it has been obtained i large quantity. In Chili it is found at several places near th town of Copiapo and Coquimbo. Near Limach it is foun with native mercury.

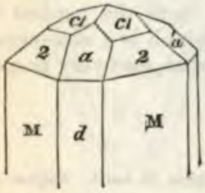
DICHLORIDE OF MERCURY.

Horn Quicksilver. Quecksilber Hornerz, W. Mercure Muriaté, H. Chlorquecksilber, *Berzelius.* Pyramidal Pearl Kerate, M. Pyramidal Corneous Mercury, J. Muriate of Mercury. Calomel, *Beudant.* Ceratus quadratus, D.

It does not appear that the mineral has been accurately analyzed, but its composition is supposed to be the same with the artificial calomel, which consists of chlorine 15·26 of mercury 84·74; or one atom chlorine to two atoms mercury. Formula; H^2Chl.

Sp. Gr. 6·48. H. = 1·5 — 2·0.

Color greyish-white, grey, yellowish and greenish-grey; sometimes occurs crystallized in distinct quadrangular prisms terminated by pyramids. Primary form a Right square prism. It is also in tubercular crusts; sometimes fibrous; rarely compact; is occasionally translucent, with an adamantine or vitreous lustre; and is sectile; fracture conchoidal or uneven. B B, on charcoal, it is totally volatilized if pure; in the matrass it affords a white sublimation, and mixed with soda forms numerous globules of mercury.



M on M	90° 00′
M or M on c1 or c1	129 30 ?
————— c2 or c2	158 00
————— d	135 00
a on d	119 30 ?

The preceding figure and measurements are on the authority of Brooke.

The principal locality of this rare mineral is Moschellandsberg in Deux Ponts, where the crystals are often large and well defined, coating the cavities of a ferruginous gangue, and associated with cinnabar; but it is also met with in the quicksilver mines of Idria in Carniola, at Almaden in Spain, and at Horzowitz in Bohemia.

CHLORIDE OF MERCURY, or NATIVE CORROSIVE SUBLIMATE. The existence of this species, though affirmed by some mineralogists, is very doubtful; and we have no accurate or even partial descriptions of it.

IODIC MERCURY.

Iodure de Mercure, or Mercure Ioduré, *Necker.* Iod-Quecksilber, *Del Rio* and *Leonhard.*

In spots of a fine lemon-yellow color, in the variegated sandstone of Casas Viegas, Mexico. Exposed to the air, as well as in ammonia, it changes to black. It resembles the artificial protiodide of mercury. — *Shepard.*

CLASS VIII.

COMBUSTIBLE MINERALS.

THIS class, with one exception, consists of those minerals which the base is sulphur or carbon. It includes substances the most opposite external characters; both the hardest a the softest in nature. Selenium, also, which is a non-metall substance, and most nearly allied to sulphur, may very proper be comprised under the same head.

SULPHUR.

Natürlicher Schwefel, W. Soufre, H. Prismatic Sulphur, M. and J. Sulphur py midalis, D.

Sp. Gr. 1·9—2·1. H. = 1·5—2·5.

Color when pure, citron-yellow; from accidental admixtur sometimes red, brown, yellowish-grey, and even green. Pr mary form an Octahedron with a rhombic base, P on P 10 30′, according to Phillips.* It occurs massive, disseminate investing other minerals, and crystallized in the form of a acute four-sided pyramid, either perfect or variously modified cleavage imperfect and interrupted; fracture conchoidal, ur even in the impure varieties; lustre shining and resinous varying from transparent to translucent on the edges; ver brittle. It burns readily with a lambent blue, or white flame according to the low or high degree of temperature, emittin at the same time a pungent smell of sulphurous acid, an fuses into a brown liquid. It acquires resinous electricity b friction.

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[*] The primary form, according to Haidinger, is a Right rhombic prism M on M′ 101° 5 and this seems to be adopted by Brooke.

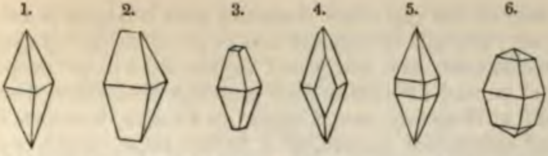
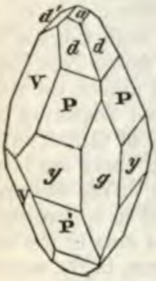
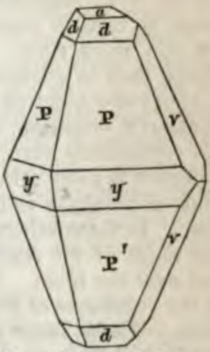


Fig. 1, the primary octahedron. Fig. 2, the same elongated. Fig. 3, the same, having its summits replaced. Fig. 4: in this two opposite solid angles of the octahedron are replaced by rhombic planes. Fig. 5: in this the edges of the base of the pyramid are deeply replaced by quadrangular planes. In fig. 6, the summits of the primary are replaced by four triangular planes, forming a low pyramid on each. These replacements are also shown by the succeeding figures, the last of which has the acute pyramidal edges replaced by tangent planes.

7.



8.



P on P	106° 30′	106° 38′ Haüy.
P on P over v	85 5	84 58 ——
P on P′	143 25	143 26 ——
d on *d*		127 1 ——
v on *v*		124 24 ——
y on *y*		101 59 ——
d on *a*		179 45 ——*

Sulphur occurs principally in two kinds of repositories, either in gypsum and salt rocks, as in the valleys of Noto and Mazara in Sicily, at Conil near Cadiz in Spain, and at Cracow in Poland; or in the vicinity of active and extinct volcanoes. In the latter case it is the result of sublimation, forming either crystals in the clefts and cavities of the rock, or crusts, stalactites, and loose efflorescent coatings. In small quantities it is likewise met with in certain metalliferous veins, as in Savoy, Switzerland, Hanover, &c. In Iceland it is deposited by hot springs, and many of the natural medicinal waters both of this and other countries hold it largely in solution. In Sicily, crystals of sulphur two or three inches in diameter are occasionally met with; and by much the larger proportion of what is used for commercial purposes is obtained from that island; at Radoboy, near Crapina in Croatia, it occurs in imbedded spheroidal masses, of a brown tinge, which is owing to bitumen; and in the dark-reddish colored sulphur of the Lipari Islands, Stromeyer detected selenium. — *Allan's Manual.* Fine specimens of native sulphur have been brought from the Sandwich Islands. According to Dana, the crystallized variety is particularly beautiful at the sulphur bank, Lua Pele, Hawaii. In various parts of the Andes, throughout the whole range of this extensive chain of mountains, sulphur is found in great abundance, occurring in craters of extinct volcanoes; in beds in gypsum, and forming veins in porphyry, trachyte and mica slate. In the northern part of Chili, it forms large beds in gypsum, and on the high ridge of the Cordillera, about one hundred and twenty miles from Copiapo in a south-eastern direction, are extensive mines, the sulphur of which is remarkably pure, much of it not requiring to be refined before it is used. In the province of Quito, in Peru, in mountains of porphyry and of mica slate, there are large veins of sulphur. In the southern part of Peru, on the western side of the main range of the Andes, it is found in spheroidal masses scattered over the plain. It is abundant also in the neighborhood of the volcanoes of Putana and Soras, in the western part of Bolivia. These latter places afford fine crystals. — *Blake.*

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* Only the three first measurements are by Phillips. The others, with fig. 8, have been copied from Haüy.

In the United States native sulphur has been found in very small quantity associated with gypsum, as in Cayuga and Onondaga counties, N. Y., and in thin layers of efflorescences covering leaves, twigs, &c., in the vicinity of sulphur springs, which are charged with sulphydric acid gas. According to Prof. Beck, it occurs in a pure form in granite near West Point. But usually the small quantities of sulphur that have been met with arise from the decomposition of iron pyrites.

NATIVE SELENIUM.

This is a very rarely occurring substance, and forms usually a thin red coating on sulphur, or sometimes small globular or botryoidal masses, with smooth and bright surfaces. Fracture conchoidal. Lustre vitreous. Translucent. Color pale dull red. It is found in an uncombined state only in the Lipari Islands. It exists in combination with sulphur at Fahlun in Sweden, and was originally discovered by Berzelius. Its combination with sulphur (sulpho-selenite) gives rise to a brownish colored mineral, massive, occurring with salamoniac in the same islands. Its combinations with silver, lead, copper, and one or two other metals, have been described under their appropriate heads in this treatise; as has also its single occurrence as an acid combined with oxide of lead.

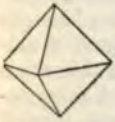
DIAMOND.[*]

Octahedral Diamond, M. J. Diamond, W. and H. Adamant. Adamas octahedrus, D.

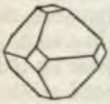
Pure carbon. Symbol, C.
Sp. Gr. 3·55. H. = 10·0.

Diamonds are either colorless, or of a yellowish, bluish, yellowish-green, clove-brown, or rose-red tinge. Primary form the Regular octahedron; always found in detached crystals, the varieties of form in which are numerous; the faces often convex, giving its crystals a spherical appearance; frequently macled; structure perfectly lamellar, yielding readily to cleavage parallel to the planes of the octahedron; lustre brilliant adamantine; fracture conchoidal; varies from transparent to nearly opake. At a heat less than the melting point of silver (viz. at 14° Wedgewood) it gradually dissipates, burns, and, combining with nearly the same quantity of oxygen, forms the same volume of carbonic acid as charcoal, whence it appears to consist of pure carbon. It is not acted upon by acids or alkalies; possesses vitreous electricity when rubbed; and, after exposure to the solar rays, presents in the dark a distinct phosphorescence.

1.

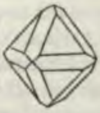


2.



3.

4.



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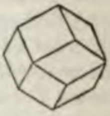

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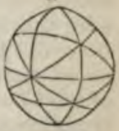
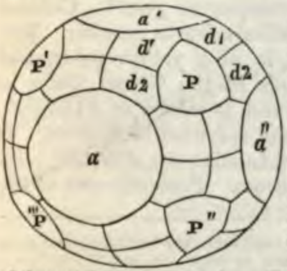


For transitions of figs. 1, 2, 3, 4, 5, see Red Oxide of Copper, p. 486.



The crystal represented by the annexed figure was selected, as exhibiting, with more than usual beauty and precision, the planes of the primary octahedron P, P', P'', and P''', and those of the cube *a*, a', and a'', which are generally flat and brilliant. The numerous faces *d*1 and *d*2 are uniformly convex; each of these faces is in reality a series of planes, as is manifest on other crystals, but in no instance sufficiently perfect for the use of the reflective goniometer. In the last of the small preceding figures, these faces are shown to the exclusion of the planes of the octahedron and cube. The true angles of these solids are:

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[*] Perhaps from *adamas* of Pliny, signifying *unconquerable.* It is probable that Pliny, when speaking of the gem called adamas, had in view, among other things, the diamond;

P on P′ or P″	109°	28′	16″
P on *a*, *a*′, or *a*″	125	15	52
a on *a*′ or *a*″	90	00	00

he rocks hitherto considered as the matrix of the di
econdary ones, as several kinds of sandstone, con
ggregated quartz pebbles; it is also found in st
shot sand and clay, and in the alluvium of plai
s.

ndostan and Brazil are the principal localities of th
l, and in both these countries it is confined to the tr
dia, where it has for ages been an article of comm
met with in the district between Golconda and Mas
near Parma in Bundelcund, where some of the most
ent specimens have been found; and extensively o
anuddy, and in the vicinity of Ellore. Up to the
ement of the last century, diamonds where wholly de
India and Borneo. In 1829, they were first disco
e Ural Mountains by the expedition under Baron
; they are found in the same alluvial deposits wit
In Brazil, the district of Minas Geraes compreh
r as is known, the whole diamond grounds of the A
continent. Diamonds occur among the gold san
iver Gumil, province of Constantine, in North A
have been sold by the natives to the Sardinian Co
zo, who sent them to France. Two of these were
d for the Garden of Plants. Bronginart reminds us,
ago, the Carthaginians traded with diamonds they bro

largest and most beautiful colored diamonds, is a rich sky-blue brilliant belonging to the crown jewels of France. It weighs sixty-seven carats, and its value is estimated at three millions of livres. The late Duke of York possessed a diamond which approached very nearly to jet black, and possessed peculiar beauty and brilliancy. The largest and most magnificent specimens have hitherto been brought from the East. The Pitt or Regent Diamond, for instance, the prime ornament of the crown jewels of France, weighing one hundred and thirty-six carats, was found in the Golconda district; its value is estimated at twelve millions of livres. Though not the largest, it is supposed to be the finest in the world. The kings of France wore it in their hats, and Bonaparte had it fixed to the pommel of his sword. That of the emperor of Russia, the weight of which is one hundred and ninety-three carats, is said to have once formed the eye of an Indian idol, and is doubtless from the same vicinity. Russia has several large diamonds besides those which adorn the imperial sceptre. One of them is valued at £369,800. There is also a large table diamond belonging to the imperial treasury. Holland has one of thirty-six carats, valued at £10,368. Persia has several, four of them large ones of a rose cut, besides brilliants; the two principal are called the "Sea of Glory," and the "Mountain of Splendor." The Rajah of Mattan possesses one of three hundred and sixty-seven carats, which was found in Borneo; and that of the Great Mogul is said, in its rough state, to have weighed not less than eight hundred carats. In Brazil, although of fine *water*, they rarely exceed twenty carats. It is stated that the number of known diamonds of the weight of thirty-six carats and above, do not amount to more than nineteen or twenty. According to Mawe, the number in Europe of large size does not exceed half a dozen.[*]

PLUMBAGO.[†]

Rhomboidal Graphite, J. Graphit, W. Fer Carburé, H. Rhombohedral Graphite Mica, M. Black Lead. Carburet of Iron. Plumbago Scriptoria, D.

Combination of a considerable quantity of carbon, with a small proportion of iron.

		Cornwall.	Bustletown, Penn.
Carbon	91·9	96·0	94·4
Iron	9·1	4·0	4·6
	100·0 Bertholet.	100·0 Saussure.	99·0 Vanuxem.

Sp. Gr. 2·08 — 2·45. H. = 1·0 — 2·0.

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[*] See Mawe on Diamonds and Precious Stones; also his Travels in Brazil: and a Memoir on the Diamond, by John Murray, F. G. S., &c. London, 1831.

[†] Plumbago, from its drawing like lead (its streak being of the same color). Graphite, from the Greek, to draw; in allusion to its use.

Color iron or steel-grey. Primary form a regular Six-sided prism. It occurs in kidney-shaped masses, or disseminated in rocks; also, though rarely, crystallized in regular six-sided prisms, of which the summits are striated parallel to three of their edges; cleavage perfect perpendicular to the axis. It has a glistening metallic lustre, a granular and uneven fracture; is unctuous to the touch; sectile, and the thin laminæ very flexible; not very brittle; streak lead-colored and shining. B B, it becomes yellow or brown after long-continued heat, but is infusible; and is not affected by the addition of any re-agent.

It belongs chiefly to primitive rocks, and to the coal formation. The purest and most esteemed plumbago is found at Borrowdale in Cumberland, where it occurs in rocks consisting chiefly of grauwacke, and whence it is obtained in considerable quantity for the manufacture of pencils. It occurs crystallized at Pargas in Finland, in Greenland, and in the United States; in scales like mica at Arendal in Norway; forming irregular masses imbedded with particles of garnet in gneiss, at Strathferran near Beauly in Aberdeenshire; passing into a kind of columnar coal at Craigman in Ayrshire; at Passau in Austria; in Ceylon; and many other places.

Graphite is frequently disseminated through the primitive rocks of the United States, associated with various other minerals; as with the Brucite, spinelle and garnet, in Sussex county, N. J., and Orange county, N. Y.; the apatite and zircon, St. Lawrence county, N. Y.; in Bucks county, Penn., with tabular spar, pyroxene and scapolite. At some of these localities, it is pretty uniformly diffused through a beautiful white limestone in small brilliant compressed laminæ, extremely soft. The massive variety occurs at Ashford and Cornwall, Conn.; Sturbridge, Mass.; Thomaston, Me.; Withingham, Vt.; Goshen, Antrim, and Bristol, N. H. At most of these last named localities it forms veins in gneiss which are of sufficient extent to admit of profitable mining. In Bucks county, Penn., a workable deposit of it exists in sienite. According to Dr. Jackson, the plumbago from Antrim, N. H., is soft and suitable for pencils. The handsomest crystallized specimens of plumbago, are said to have been found near Ticonderoga, on Lake George.

Besides being extensively used in the fabrication of pencils, graphite is employed in the manufacture of crucibles, particularly those required for the purposes of the mint, as they sustain intense heat, and are esteemed for their tenacity and expansibility. It is also used to diminish friction, to protect iron from oxidation, and to impart a polish to ornamental iron work.

ANTHRACITE.*

Glanzkohle, W. Blind Coal. Anthracite, H. Bt. Blende Charbonneuse, Br. Non-bituminous Mineral Coal, M. Kilkenny Coal. Glance Coal, J. Kohlenblende, L. Anthrax lapideus, D.

Combination of carbon, with a small proportion of silica and earthy matter and water.

	Tarantaise.	Swansea, Wales.	Lehigh, Penn.	Rhode Island.
Carbon	72·05	92·56	90·1	90·03
Silica	13·19	2·53	1·2	2·14
Oxide of iron	3·47	1·58	0·2	2·50
Alumina	3·29	0·09	1·1	0·00
Water	0·00	3·33	6·6	4·90
	92·00 Dolomieu.	100·00 Regnault.	99·2 Vanuxem.	99·57 Vanuxem.†

	Mayenne.
Carbon	91·98
Silica	3·16
Oxide of iron	0·94
Water	3·92
	100·00 Regnault.

	Portsmouth, R. I.	Mansfield, Mass.
Carbon	85·84	92
Water	10·50	6
Oxide of iron, silex and alumina	3·66	00
Oxide of iron and alumina	0·00	2
	100·00 Jackson.	100 Jackson.

It appears from these analyses, that the American and foreign anthracites present about the same composition. The mean of twenty analyses of anthracite from different mines in Pennsylvania, by Prof. Rogers, gives about eighty-seven per cent. of carbon, eight of water, and five of earthy matter.

Sp. Gr. 1·4 — 1·8. H. = 2·0 — 2·5.

Of this substance there are three varieties. *Massive Anthracite* is of an iron-black color, often superficially tarnished and iridescent, and occasionally with a splendent metallic lustre; fracture conchoidal and shining; is light and brittle. It burns without flame or odor, leaving a whitish ash, when contaminated with only a small portion of oxide of iron. It occurs at Meissner in Hesse.

Slaty Anthracite has a brownish-black color. The structure is imperfectly slaty in one direction, with a somewhat metallic lustre; fracture flat conchoidal; easily frangible, somewhat sectile, and brittle.

The deposits of anthracite in the State of Pennsylvania, are probably more extensive than those of any other country. The States of Massachusetts and Rhode Island, afford beds of moderate extent and thickness, which, however, have been but partially explored. It is estimated by Prof. Rogers that the anthracite mines of Pennsylvania furnished, during the year 1838, upwards of *nine hundred thousand tons* of this valuable combustible. The quantity now supplied is much greater. "The southern anthracite coal basin of

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* Anthracite, from the Greek; consisting of carbon.

† Journ. of the Acad. of Nat. Scien., Philad., v. 17.

Pennsylvania, where the most extensive mining operations are carried on, occupies an area of sixty miles in length, and two in average breadth, having in the middle, an aggregate thickness of coal, exceeding one hundred feet. This is all *above* the water level, below which hundreds, nay thousands of feet of coal lie still untouched." — *Prof. Rogers' Second Annual Report on the Geology of Pennsylvania.*[*]

In England it is found in the coal-formation near Walsal in Staffordshire (*Stone Coal*); in Wales, in the southern parts of Brecknockshire, Carmarthenshire, and Pembrokeshire (*Welsh Culm*); in the same situation near Cumnock and Kilmarnock in Ayrshire, and many other parts of Scotland (*Blind Coal*); and at Kilkenny in Ireland (*Kilkenny Coal*).

Columnar Anthracite occurs in short prismatic concretions, either straight or curved; of an iron-black color, with a shining metallic lustre, and occasionally tarnished externally. It is opake, soft, light and brittle. It burns without flame or smoke. It is principally found at the Meissner, in Hessia, forming the upper portion of a bed of brown coal, which is covered by basalt; at Craigman in Ayrshire, also, and in some of the Newcastle pits, it occurs in contact with dykes of greenstone, at the former frequently passing into plumbago.

These varieties being more difficultly inflammable than bituminous coal, are principally used in lime-kilns, malt-kilns, iron foundries, and such like; for when ignited in considerable quantity they burn with a strong and durable heat; and indeed much of the difficulty of kindling may be overcome by the addition of some charcoal, and the judicious application of a current of air. In the United States, particularly in New England, where bituminous coal is not found, this forms the principal fuel of the maratime cities, and is applied to nearly every purpose, for the production of heat in the domestic use, in the arts and manufactures. Recently it has been applied to the smelting of iron ores with hot air-blast, in Great Britain and the United States. — See *Notes on the Use of Anthracite in the Manufacture of Iron, by W. R. Johnson.*

Closely allied to the present species is the *Mineral Carbon* or *Mineral Charcoal*, which occurs in thin layers, and fibrous distinct concretions of a delicate silky black color, in most of the coal fields of Great Britain; at Voitsberg in Styria; Disko Island, Greenland, Pennsylvania, and elsewhere.

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[*] For an interesting account of the vast coal deposits of Pennsylvania, see articles by Prof. Silliman, in the Amer. Jour. of Science, vols. xviii. and xix.

MINERAL OIL.

Under this term is comprehended two substances, Naphtha and Petroleum; both of which are liquid, highly inflammable, and lighter than water.

I. NAPHTHA.*

Bitume Liquide Blanchatre, H. Le Naphte, Br. Bitume Napthe, Bt.

Carbon	82·2	87·60
Hydrogen	14·8	12·78
	97·0 Thomson.	100·38 Saussure.

It is nearly colorless, sometimes yellow, and transparent; it burns with a white flame, much smoke, gives out a penetrating odor, and leaves no residuum. It dissolves resins, but is not itself soluble either in alcohol or ether.

It is found in large quantity in Persia, and in the Birman empire. At Rangoon there are said to be upwards of five hundred naphtha wells, which yield annually about four hundred and twelve thousand hogsheads. It is of essential use in the manufacture of varnish, and is preferred to oil in the formation of oil paint, from its property of drying with great rapidity. Like alcohol, it is employed for removing spots of grease from woollen and other stuffs, but it is difficult to destroy the disagreeable odor which it emits. Near the Caspian, and elsewhere in Persia, it is used instead of oil for lamps.

II. PETROLEUM.†

Bitume Liquide Noiratre, H. Petrol, Br. Bitume Petrole, Bt.

Petroleum, at the usual temperature, is rather thicker than common tar, has a strong disagreeable bituminous odor, and is of a blackish or reddish-brown color. It is very combustible, emitting during ignition a thick black smoke, and leaving a little residue in the form of black coal.

It is found in many countries, principally in those producing coal. At several places in France. In England, at Ormskirk in Lancashire, and at Coal Port, near Coalbrookdale. In Scotland, at St. Catherine's Well near Edinburgh, and in the Isle of Pomona, one of the Hebrides. It occurs also in Bavaria, Switzerland, and in Italy, near Parma. At the latter place the petroleum gives out so powerful an odor that the workmen cannot long endure it at the bottom of the petroleum wells without danger of fainting. It is found in many other parts of Europe, and in America.

In the United States, this variety is met with in Virginia,

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* From the Greek, signifying to take fire.

† From two Greek words, signifying rock or mineral oil.

cky, Ohio, New York, and elsewhere. It is seen
the surface of Seneca Lake, N. Y., and has hence
Seneca oil.

en naphtha is exposed to the air and light, it be
, thickens, and seems to pass into petroleum ; and
eum is distilled, an oil is obtained similar to na
petroleum is exposed to the air, it thickens and
kind of bitumen. Considerable alliance is thus p
st between mineral oil and bitumen.

BITUMEN.

bitumen there are three varieties.

I. EARTHY BITUMEN.

Erdpech, W. Bitume Glutineux, H. La Poix Minerale Terreuse, Br.
Mineral Pitch, J. Malthe, *Beudant.*

s blackish-brown, and dull; fracture earthy and un
nough to take an impression of the nail; sectile, an
a strong bituminous odor. It burns with a clear
, emits a powerful smell, and deposits much soo
sts of inflammable matter, mingled with a conside
rtion of earthy substances.

s found in Persia, between Schiraz and Bender-c
coal mines of Hurlet near Paisley, enclosing cryst
eous spar; in East Lothian, and other places. It
ally used as a pitch, and in the fabrication of c
hes.

III. COMPACT BITUMEN. ASPHALT.

Schlackiges Erdpech, W. Bitume Solide, H. La Poix Minerale Scoriacée, Br. Bitume Asphalte, Bt. Slaggy Mineral Pitch, J.

Varies from brownish-black to black; occurs massive, with a conchoidal fracture, and shining resinous lustre; is opake, and very brittle. Specific gravity 1 — 1·6. When rubbed, it gives out a bituminous odor. By combustion, it leaves a small quantity of ashes. It consists chiefly of bituminous oil, hydrogen gas, and charcoal, but the latter is in greater proportion than in elastic bitumen. Like the elastic variety, it is often soft when found, but soon hardens.

This is much the most common variety of bitumen. It is found in the Palatinate; in France; at Neuchatel in Switzerland; in large strata in Avlona in Albania; and in masses on the shores or floating on the surface of the Asphaltic lake in Judea, called the Dead Sea. It abounds in the Island of Barbadoes and Trinidad; in the latter it forms with sand a lake three miles in circumference, called the Pitch Lake, the thickness of which is unknown. A gentle heat renders it ductile, and when mixed with grease or common pitch it is used for paying the bottoms of common ships. The ancients employed bitumen in the construction of their buildings, and the Egyptians used it for embalming.

It appears from the intelligent American missionaries who have visited Western Asia, that this mineral is now but seldom found on the shores of the Dead Sea, even in small masses, however plentiful it may have been in former times. According to Mr. Smith, it has been known to make its appearance in considerable masses only after an earthquake. That of 1834, caused a large quantity to rise, of which the Arabs brought about six hundred pounds to market. See an interesting paper on the Geology of Western Asia, compiled from notes of American missionaries, by Prof. Hitchcock, in the *Reports of the Association of American Geologists*, i. 371. Bitumen is found in small quantity in several parts of the Andes of Chili. In the Island of Cuba, solid bitumen (called Chapapote) is found near the towns of Havana, Trinidad and Villa Clara. Its color varies from reddish brown to jet black. Fracture conchoidal. — See analysis of Chapapote and some account of the extensive coal mine near Havana, by J. H. Blake, in the *Amer. Jour. of Science*, xlii. 388.

BITUMINOUS COAL.

Schiefferkohle, Blätterkohle, Grobkohle, W. Houille, H. Slate-Coal, Foliated Coal, Coarse Coal, J. Bituminous Mineral Coal, M. Anthrax bituminosus, D.

Sp. Gr. 1·2 — 1·5. H. = 1·0 — 2·3.

It is of a black color, frequently with an irridescent tarnish. It occurs massive; the structure in one direction is slaty, sometimes it is so in two directions; the fragments vary in shape from nearly the proportions of the cube, to those of rhombic prism greatly resembling that of mica; it sometimes contains thin parallel layers of mineral carbon; fracture small and imperfectly conchoidal, frequently with a brilliant semi-metallic lustre. It burns with a bright flame and much smoke; but this coal commonly contains some proportion of earthy ingredients.

The composition of the principal foreign varieties of bituminous coal is shown by the following table, compiled from different sources.

	Carbon.	Volatile Matter.	Cinde
Best Cannel Coal. — *Kirwan*	75·2	21·7	3
Newcastle Coal	64·28	32·52	3
Common Lancashire Cannel Coal	62·22	35·28	2
" Derbyshire " "	48·36	47·01	4
" Scotch " "	39·43	56·57	4
Whitehaven Coal. — *Kirwan*	57·0	41·3	1·
Wigan. — *Kirwan*	61·7	36·7	1
Swansea. — *Kirwan*	73·5	23·1	3
Lutrim	71·4	23·4	5
Pictou Coal, Nova Scotia. — *J. H. Blake*	54·20	30·80	15
Clyde. — *Berthier*	64·4	31·0	4
Northumberland. — *Berthier*	67·5	30·0	2
Yorkshire. — *Mushet*	67·14	30 73	9·
Arauco Coal, Chili. — *W. R. Johnson*	67·62	27·80	2
San Miguel, Cuba. — *J. H. Blake*	71·84	14·62	13
Ausin. — *Berthier*	71·5	25·	3
Balayre. — *Berthier*	58·5	42·4	7
Alais. — *Berthier*	68·0	21·6	10·

The following table shows the composition of some of th principal varieties of American bituminous coal.

	Carbon.	Volatile Matter.	Cinde
Cumberland Coal, Maryland. — *T. P. Jones*	78·	19·	3·
" " " *C. T Jackson*	77·09	16·05	6·
" " " *A. A. Hayes*	77·80	15·60	4
Hoffman Mine, Frostburg, Md — *Silliman.*	76·77	14·66	8
Bear Creek, Blosburg, Penn. } *T. G. Clemson.*	73·74	15·	11
Johnson's Creek, " "	69·3	14·6	16
Coal Run, " "	75·4	16·4	8
Willis' Pit, Richmond,	66·6	28·8	4
Anderson's Pit, "	64·2	16·0	9
Cannelton Coal, Indiana, } *J. H. Blake.*	61·93	35·96	2·
Mid Lothian Coal, Virginia,	60·03	30·94	8
Frost's Mine, Maryland. — *Prof. Ducatel*	70·	20·50	9
Mid Lothian, Va. — *Profs. Silliman and Hubbard.*	61·	31·6	7·

Dr. Thomson inclines to the opinion that coal is a direc combination of carbon, hydrogen, oxygen and azote, and not compound of bitumen, &c., as has been supposed; and he ha stated the composition of several varieties, giving the proportions of carbon, hydrogen, oxygen and azote. Thus: *Newcastle*, or *coking coal*, carbon 75·28, hydrogen 4·18, azote 15·96, oxygen 4·58. *Splint*, or *light-burn hard coal*, from Glasgow, used for making coke and smelting iron, carbon 75, hydrogen 6·25, azote 6·25, oxygen 12·5.

It occurs in many countries of the European continent, and is the common coal of the most extensive British collieries. In Nova Scotia, New Brunswick and Cape Breton, bituminous coal abounds in the New red sandstone and shale. The Pictou and Sydney mines have been the most extensively explored. The coal from the former is peculiar on account of the abundance of mineral charcoal it contains; and, for domestic purposes, this is thought to give it an advantage over the Sydney, and most other bituminous coal, by preventing it from cementing together while consuming.

In the United States, extensive beds of bituminous coal exist in Virginia, Maryland, and several of the Western States. The mines in the neighborhood of Richmond, Va., have been the longest explored, and they continue to supply various parts of the country with a valuable combustible. According to Prof. Rogers, the coal measures at the Mid Lothian mines, where the coal beds are very thick and pure, rest immediately upon granite. The Cumberland coal mines of Maryland, from their central position, and the unsurpassed excellence of the coal they have furnished, promise to become of very great value. This coal is even purer than the imported cannel coal, as it contains, according to the analysis of Dr. T. P. Jones, carbon 78, bitumen 19, alumina and oxide of iron only 3. Bituminous coal occurs plentifully in Ohio and Indiana, and one of the most extensive and valuable deposits is at Cannelton, Perry county, in the last named State.

1. CANNEL COAL. Kennel Kohle, W. Houille, H. Of a greyish-black color, and occurs massive; fracture large and flat conchoidal, with a glimmering resinous lustre; brittle. Specific gravity 1·2. It burns with a bright flame, but at the same time decrepitates and flies into angular fragments. It is common in the upper beds of our coal deposits, as near Wigan in Lancashire, at Clee Hill in Shropshire, and Newcastle; and in Scotland, at Gilmerton near Edinburgh, and Muirkirk in Clydesdale. The name Cannel is supposed to be derived from the word candle, because in some places it is used as a substitute. In Scotland it is termed Parrot coal. As it receives a polish, it is occasionally made into snuff-boxes, inkstands, &c.

2. *Jet.* Pechkohle, W. Jayet, H. Pitch Coal, J. Jet generally of a velvet-black; it occurs in elongated renifor masses, and sometimes in the shape of branches, with a reg lar woody structure; this structure is visible internally only transmitted light and in specimens cut extremely thin; it h then a brown translucent appearance. It presents a brillia resinous lustre, and a perfect conchoidal fracture; is soft a brittle, and little heavier than water; burns with a greeni flame and strong bituminous smell, leaving a yellowish as Jet occurs principally in marly, schistose, or sandy beds, several places in France, where it is sometimes found enclosi amber; near Wittemberg in Prussia; and in detached fra ments, in the amber mines on the coasts of the Baltic. England it occurs in aluminous shale, at Whitby in Yorkshi It is worked into various trinkets, chiefly worn as part of t mourning habit; but when not sufficiently fine and hard that purpose, it is used as fuel.

3. *Brown Coal.*— Braunkohle, Lignite, W. This substan is perhaps principally characterized by its odor when in a sta of combustion, which resembles that of peat; the flame weak; it appears to have but little analogy with common co It occurs massive, and brown, of various shades, and brownis black *(Moor coal);* the fracture is earthy, or fibrous, and the latter case it generally possesses more or less of the stru ture of wood *(Wood coal);* but it is frequently sufficient compact to afford a more or less perfect conchoidal fractur with a somewhat resinous lustre, and is nearly black. It yiel to the knife, occasionally to the pressure of the nail; 20 grains of the Bovey brown coal afforded on distillation 60 grai of water, acidulous and bituminous; 21 grains of thick bro oily bitumen; 90 of charcoal; and 29 of mixed gases, hydr gen, carburetted hydrogen, and carbonic acid.

The earthy and fibrous varieties occur together in Thuri gia, in the circles of Saale and Leipsic, and at the Meissner Hessia, forming beds 20 to 40 feet thick, and several squar miles in extent; also in France, Silesia, Bavaria, and othe European countries. In England, the fibrous and compa kinds *(Bovey coal)* are found near Bovey Tracey in Devon shire, forming beds of various thickness, interposed betwee brownish clay; small veins of coal are found in the clay together with retinasphalt. The fibrous variety also occurs the mouth of the Ouse in Sussex; abundantly in the Faro Isles, particularly Suderoe; and in the county of Antrim im bedded in trap.

DYSODILE.

Dysodile, *Cordier.* **Houille Papyracée**, *Lucas.* **Merda di Diavolo** *des Siciliens.*

It occurs in masses of a greenish-grey or yellow color, and either compact or laminated, sometimes both. It is extremely fragile, emits an argillaceous odor when breathed on, and is of the specific gravity of 1·146. It burns with a considerable flame and smoke, and an almost insupportably fetid odor, with a crackling noise, leaving a residue of nearly half its weight, unaltered in form. Macerated in water, it becomes translucent, and its laminæ acquire flexibility.

It occurs at Melili, near Syracuse, in a bed in secondary limestone.

AMBER.

Bernstein, W. Succin, H. Yellow Mineral Resin, M. and J. Succinuum electrum, D.

Contains Carbon	80·59	70·68
Hydrogen	7·31	11·62
Oxygen	6·73	7·77
	94·63 Drapier.	90·07 Ure.

Sp. Gr. 1·0 — 1·1. H. = 2·0 — 2·5.

In irregular nodules, masses, or grains, generally of a yellow or yellowish-white color; sometimes reddish-brown. It is brittle, and yields easily to the knife; is occasionally transparent, always translucent; fracture more or less perfectly conchoidal, with a vitreous or resinous lustre. Resinous electricity easily produced by friction; this property gave rise to the science of electricity, which was so called from Ηλεκτρον, the Greek name for amber.

It yields by distillation an acid called the *succinic acid*, and leaves an extremely black, shining residue, which is employed as the basis of the finest black varnishes. It burns with a yellow flame, emits an agreeable odor, and leaves a light, shining, black coal. Is soluble in alcohol. The experiments of Sir David Brewster on the optical properties of amber, leave no doubt of the origin of this substance being derived from the vegetable kingdom, as the traces of regular structure indicated by its action on polarized light are not the effect of the ordinary laws of crystallization by which mellite has been formed, but are produced by the same causes which influence the mechanical condition of gum arabic and other gums, which are known to be formed by the successive deposition and induration of vegetable fluids.

The largest specimens of amber occur on the Prussian coast, where it is disengaged by the action of the waves, and cast ashore. It also occurs occasionally, presenting very peculiar tinges of blue, on the Sicilian coast near Catania; imbedded in brown coal at Hasen Island in Greenland; in Poland, France, Italy, and many other countries; and occasionally in the beds of gravel in the neighborhood of London, and on the coasts of Norfolk and Suffolk. In the United States it has been found in the alluvial deposits of sand and gravel at Cape Sable, Maryland. Of those insects which have been originally enclosed in amber, some have evidently struggled hard for their liberty, and even left their limbs behind them in the attempt; it being no unusual thing to find in a mass of amber which contains a stout beetle, the animal wanting one or perhaps two of its legs, and those limbs left in different places nearer that part of the mass from which it set out. This also may account for the common accident of finding legs or wings of flies without the rest of their bodies in pieces of amber; the insects having, when entangled in the yet soft and viscid matter, escaped at the expense of leaving those limbs behind them. Most if not all of these insects are unknown at th present day. — *Allan's Manual.*

Amber is used in the fabrication of ornaments by the Turks as mouth-pieces for their pipes, &c.; and considerable valu is attached to large transparent specimens. The commo varieties are used for making varnish.

HATCHETINE.*

Mountain Tallow, Mineral Adipocere, *Conybeare.* (*Ann. of Phil.*, i. 136.)

A specimen analyzed by Prof. J. F. W. Johnston, (*Lond and Edinb. Phil. Journ.*, xii. 338,) yielded carbon 76·437 hydrogen 12·479, or one atom of each element.

This singular mineral varies in color from yellowish-whit to wax and greenish-yellow. It occurs either flaky, like spermaceti, or sub-granular, like bees' wax. When flaky it has slightly glistening and pearly lustre, and a considerable degre of translucency; when sub-granular it is dull and opake. It i of about the hardness of soft tallow, and possesses neither odo nor elasticity; but is so fusible as to melt in water heated below 170°; and is very light. Specific gravity 0·916. Lik elastic bitumen, it is readily soluble in ether; and both solutions, by spontaneous evaporation, leave a viscid oily matter i separate drops, but that from Hatchetine is still inodorous while the one from elastic bitumen retains strongly the peculiar odor of that substance. Hatchetine distilled over th

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[*] So named in honor of the eminent chemist Chas. Hatchett, Esq., F. R. S.

naked flame of a spirit-lamp assumes the bituminous smell, and yields a butyraceous substance of a greenish-yellow color, a coaly matter remaining in the retort; at a lower heat it affords a light oil.

It occurs among the coal measures of Glamorganshire, and in some of the Midland counties of England. Also, with calcareous spar and small quartz crystals, in iron-stone at Methyr Tydvil in South Wales.

SCHERERITE.

Schererit, *Stromeyer*. Naturliche Naphthaline, *Scherer*. Steatus acicularis, D.

Consists, according to Macaire, of carbon 73·0, hydrogen 24·0.

Exists in loosely aggregated, whitish, feebly shining, pearly, crystalline grains, and foliæ, which generally occur in nests. It is rather heavier than water, does not feel greasy, is very friable, and has no taste. It melts readily into a colorless liquid at a temperature of 112°, and in that state resembles a fatty oil, and penetrates paper in the same manner; the spots, however, thus produced, disappear when the paper is heated. On cooling, the melted mineral crystallizes in four-sided acicular crystals. When exposed to fire, it inflames and burns completely away, with a feeble aromatic smell. Is insoluble in water, but melts easily in alcohol, ether, and concentrated sulphuric acid. Occurs in beds of lignite at Ussnack near St. Gall, and at Bagh in the Westerwald, Switzerland; and was named after its discoverer, Captain Scherer.

OZOKERITE.[*]

Glocker.

Sp. Gr. 0·955. Soft.

Color yellowish-brown; translucent; has a slight odor of bitumen, and softens by the heat of the hand, so that it may be kneaded like wax. Fuses readily, and emits a stronger bituminous odor whilst doing so; burns with a clear bright flame, and leaves no residue. Not affected by acids or water, and only slightly by heated alcohol. Is soluble in ether or oil of turpentine, with a yellow color. It contains carbon 85·204, hydrogen 13·787.

Occurs in considerable masses at Slanik in the Buchau district of Moldavia, where it has been long used by the peasants for fuel.

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[*] From οζειν, *smelling*, and κερος, *wax*.

MELLITE.

Pyramidal Mellichrone Resin, M. Honeystone, J. Honigstein, W. Mellite, H. Mellate of Alumina. Mellis pyramidalis, D.

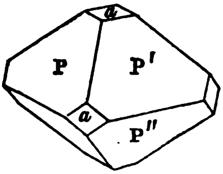
Combination of mellitic acid, alumina, and water; or a hydrous mellate of alumina:

Mellitic acid	46·0	41·4
Alumina	16·0	14·5
Water	38·0	44·1
	100·0 Klaproth.	100·0 Wöhler.

Formula, given by Dr. Thomson, from the first analysis: AlMel+4Aq. But Wöhler's comes nearer to one At. acid and one of alumina, if we take Dr. Thomson's atomic weights.

Sp. Gr. 1·58 — 1·66.

Color honey-yellow, reddish, or brown. Primary form the Octahedron with square base, in which it also occurs with the summits of the octahedron truncated. Cleavage parallel to the planes of the primary, but difficultly obtained; fracture conchoidal; transparent or translucent; lustre resinous, inclining to vitreous. It is slightly resino-electric by friction; B B, it becomes of an opake-white with black spots, and is at length reduced to ashes; when burnt in the open air, neither smoke nor flame is observable, and it eventually acquires the color and consistence of chalk. Soluble in nitric acid.



P on P′	118° 8′
P′ on P″	93 0

The mellite is a rare mineral, having hitherto only been found at Astern in Thuringia. It occurs in bituminous wood, and earthy coal, and is generally accompanied by sulphur.

RETINASPHALT.

Retinite, J. Retinasphalt, *Hatchett.* Bitumen fragrans, D.

Contains, according to the researches of Hatchett, and Dr. Troost (*Am. Phil. Trans.*, ii. 110, 1825):

Resin soluble in alcohol	55
Insoluble bituminous matter	41
Earthy substances	5
	100 Hatchett.

	Cape Sable, Md.
Resin	42·5
Bitumen	55·5
Alumina and iron	1·5
Loss	1·5
	100·0 Dr. Troost.

Sp. Gr. 1·1 — 1·2. H. = 1·0 — 2·0.

It occurs in irregular opake masses of a pale brownish-yellow color, having a glistening lustre and imperfect conchoidal fracture. It is brittle and soft; when placed on hot iron it melts, smokes, and burns with a bright flame, emitting a fragrant odor. Partly soluble in alcohol, with an unctuous residue. Though this species exhibits characters somewhat different from those of bitumen, it yet appears to be more nearly allied to that than to any other substance. The variety from Bovey Tracey in Devonshire, where it is found accompanying brown coal, has a dry earthy texture; while that from Wolchow in Moravia is hard and resinous. It was discovered in connection with amber by Dr. Troost, at Magothy river, Cape Sable, Maryland.

FOSSIL COPAL.

Fossil Copal, Highgate Resin.

Fossil copal or Highgate resin was found in considerable quantity in the bed of blue clay of which Highgate Hill, near London, in great measure consists. It is in irregular pieces of a light-yellowish and dirty-brown color, somewhat translucent, and with a resinous lustre; it is brittle, yields easily to the knife, and is but little heavier than water, its specific gravity being only 1·046. It gives out a resinous aromatic odor when heated, and melts into a limpid fluid; when applied to the candle it takes fire and burns with a clear yellow flame and abundance of smoke, as is the case with other resins; B B, it burns away without leaving any perceptible ash.

It has been found in considerable abundance at Wolchow in Moravia. Specimens have also been brought to the United States from the falls of the Wilhamet, a tributary of the Columbian river, Oregon; and from the shores of the Pacific, north of the mouth of the Columbia river.

SUPPLEMENT:

Containing further notices of several substances treated of in the body of this work, with an account of one or two others, not until now fully described as distinct mineral species. It includes also, a part of those in the Appendix to the last edition of this Treatise, several of them now having their analyses and formulas given, but respecting most of which we are yet in need of fuller information before we can admit them into the systematic arrangement of species.

SCORODITE.*

Cuprous Arseniate of Iron, *Bournon.* Cuivre Arseniaté Ferrifère, H. Martial Arseniate of Copper, J. and A. Prismatic Fluor Haloide, M. Arealus trimetricus, D.

Combination of arsenic acid, per and protoxide of iron, and water.

	Saxony.	Brazil.	Popayan.
Peroxide of iron	0·0	34·85	34·3
Protoxide of iron	47·5	0·00	0·0
Arsenic acid	31·4	50·78	49·6
Sulphuric acid	1·5	0·00	0·0
Water	18·0	15·55	16·9
Phosphoric acid	0·0	0·67	Oxide of lead.. 0·4
	98·4 Ficinus.	101·85 Berzelius.	101·2 Boussingault.

Berzelius gives the following formula, according to which the arsenic acid is in combination with both oxides of iron: $\dot{\mathrm{F}}\mathrm{e}^2\overset{\cdot\cdot\cdot}{\ddot{\mathrm{A}}}\mathrm{s}+2\overset{\cdot\cdot\cdot}{\bar{\mathrm{F}}}\mathrm{e}\overset{\cdot\cdot\cdot}{\ddot{\mathrm{A}}}\mathrm{s}+12\dot{\bar{\mathrm{H}}}$.

Sp. Gr. 3·1 — 3·2. H. = 3·5 — 4·0.

Color pale leek-green or liver-brown. Occurs in transparent or translucent prismatic crystals, terminated by four-sided pyramids; primary form a Right rhombic prism of 120° 10′ and 59° 50′, by measurements taken with the reflective goni-

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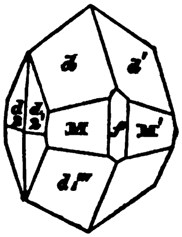
[*] From the Greek, in allusion to its emitting an alliaceous odor under the blowpipe. This mineral, as above analyzed, is found to contain no copper. I did not observe that its proper connection, among the iron ores, had been overlooked in the last edition of this work, until too late to make the correction, and have therefore brought it into the Supplement. (Am. Ed.)

ometer from natural planes; cleavage imperfect parallel to th planes M, M of the prism, and to its lesser diagonal; they a not often single, and usually are small, and grouped in a glob lar form; lustre of the crystal adamantine; streak pale gree ish-grey or white. B B, on charcoal, it emits abundant fum of arsenic, and fuses in the reducing flame into a reddi brown magnetic scoria. With the fluxes it exhibits the bottl green color characteristic of iron; and is soluble in nitric a muriatic acid.



M on M	120° 10'
M on d1	141 5
M or M on f	149 55
d1 on d1'	108 5

The brown-colored variety of this species occurs at Schwart enberg in Saxony; while the fine leek-green crystals are foun in certain of the Cornish mines, coating cavities of ferrugino quartz. Beautiful specimens have been brought from Brazi and Popayan, South America, and occasionally also fro Löling, near Huttenberg in Carinthia.

The **Neoctese** of Beudant, is the variety from St. Antoi Perreira, near Villa Ricca, in Brazil, of which the analys has just been given by Berzelius.

The above figure shows the form of the crystals of th mineral from Saxony, and the measurements are those give by Phillips, in the third edition of his Mineralogy. At th time the mineral had not been analyzed, but it is very evide from Berzelius' experiments, B B, that it contained no coppe Breithaupt first described it as a distinct species. An analys of some crystals from Cornwall, by Chenevix, and which we supposed to be the same mineral, led to its being regarded a cupreous arseniate. His analysis is here omitted.

URANIC OCHRE.

Uranium Lucino-ore, *Shepard.*

This substance has not been analyzed, and it seems prob ble that both the oxide of uranium and the carbonate hav been indiscriminately described under the same title. Th variety from Joachimsthal, was found by Zippe to contai carbonic acid, while that from Cornwall is supposed to be pur oxide, or perhaps, as suggested by Allan, the common uranite in a friable state. It presents a brilliant orange-yellow color, is extremely soft and adheres to the fingers; frequently in flocculent masses coating pitch blende; affords moisture on being heated in a glass tube; turns green in the reducing flame of the blowpipe without melting.

Dr. C. T. Jackson has recently discovered oxide of uranium at Westmoreland, N. H. It forms about two per cent. of the yellow pulverulent mineral, which encrusts the crystals of sulphuret of molybdena from that locality. This powder appears to be a mixture principally of uranic oxide, and of molybdic oxide, and the yellow color which it assumes (foreign to the latter substance) is attributed by Dr. Jackson to the presence of the former. Is it not probable that the yellow powder which accompanies the molybdena from other localities, may owe its color to the presence of the same substance?

SILLIMANITE.

The editor is indebted to Mr. Hayes for a new analysis of this mineral, which was not furnished in season to be inserted in its proper place in this treatise. It is very important, as showing that zirconia is not a constituent of the mineral, and confirming the result obtained by Bowen and Connell (see page 159). His results are as follow:

Silica	42·60	21·30
Alumina	54·90	24·40
Oxide of iron and manganese	1·10	
Magnesia	0·40	
Lime	0·31=99·31	

The formula appears to be AlS, but there is a considerable excess of alumina in each of the analyses of this mineral.

Mr. Hayes observes, "that some doubts having existed in relation to the composition of this mineral, since the analysis of a specimen was published by Muir, I have carefully tested different specimens without discovering the slightest traces of zirconia." The question asked by Dr. Thomson — is it not possible that Bowen may have analyzed Bucholzite instead of Sillimanite? — seems now to be answered in the negative.

Is it not probable that minute crystals of zircon were mixed in the specimen analyzed by Muir?

SULPHATE OF ALUMINA AND MANGANESE.

An important locality of this mineral, which had not come to the knowledge of the editor in season for earlier insertion, has been discovered on Black mountain, North Carolina, where it is abundant in the overhanging cliffs. It is a very beautiful mineral, in large irregular masses, reddish externally, the interior consisting of closely compacted silky translucent fibrous crystals. Taste like alum, but slightly metallic. B.B. on platinum wire, treated with soda, it gives a deep green bead. With borax, gives a clear amethystine glass, which before the reducing flame becomes colorless. Its analyses by Mr. J. H. Blake, gave the following results:

Alumina	12·87
Protoxide of manganese	6·20
Protoxide of iron	1·38
Sulphuric acid	33·33
Water	46·20
	99·93

Dr. Torrey had previously ascertained that it contained no alkali, and that, by the addition of sulphate of potash, it made a very pure alum. It promises to become an object of commercial interest.

UWAROWITE, OR CHROME GARNET.

This rare and beautiful mineral, described under the species garnet, page 22 of this volume, has recently been analyzed and further examined by M. Komonen. (*Transactions of the Imperial Mineralogical Society of St. Petersburg*, 1842, p. 55.) His account is as follows:—external characters; beautiful green color; lustre vitreous; crystallized in the form of rhombic dodecahedrons. These crystals are implanted on chromated iron. Chemical characters; in the alembic it gives out water; alone on charcoal, it is infusible. With phosphoric salt, and with borax, it is partially soluble, and gives with both a chrome-green colored glass. Is insoluble in acids. It is not perfectly decomposed by soda in the strongest heat, but soda and nitre mixed together decompose it easily, if the mineral is sufficiently cleansed. Specific gravity 3·41. Composition:

		Oxygen.		
Silica	37·11	19·28		2
Alumina	5·88	2·74	9·48	1
Oxide of chromium	22·54	6·74		
Protoxide of iron	2·44	0·55	9·49	1
Lime	30·34	8·52		
Magnesia	1·10	0·42		
Water	1·01			
	100·42			

Formula: $(\underset{.}{C}h, Al)S+(Cal, Mg, \underline{F})S$. Or chemically, as stated by the analyst: $(\dddot{C}r\dddot{A}l)\dddot{S}i+(\dot{C}a^3, \dot{M}g^3, \dot{F}e^3)\dddot{S}i$.

It may properly be regarded as a chrome garnet, in which the oxide of chromium has replaced a large portion of the alumina.

WASHINGTONITE. (ILMENITE.)

In page 381, this mineral, so named by Prof. Shepard, has been described as a variety of Ilmenite, from a near agreement in its physical and crystallographical characters. It has now been analyzed under the direction of Dr. C. T. Jackson, by Mr. J. S. Kendall. Its composition is quite different from that of the Ilmenite, as given under the species Ilmenite in this volume; but Mosander* has analyzed two titaniferous iron ores from Arendal, the crystalline form of which is similar to that from Ilmen, and has obtained a result which almost exactly accords with that of the Washingtonite. It seems to be shown that the essential constituents of this mineral — titanic acid and the two oxides of iron — so interchange with each other as to produce these several varieties, while the crystalline form remains the same in each. The analyses are as follow:

			Atoms.	
Titanic acid	24·19	25·28	4·82	1
Peroxide of iron	53·01	51·84	10·36	2
Protoxide of iron	19·91	22·86	5·08	1
Magnesia and lime	1·01	0·00		
Silica	1·17	0·00		
	99·29 Mosander.	99·98 J. S. Kendall.		

We thus obtain from the results of the last analysis very nearly one atom titanic acid, two atoms peroxide of iron, one atom protoxide of iron; or a trititaniate of iron, consisting of two At. trititaniated peroxide, and one At. trititaniated protoxide. Formula: $2\underset{\cdot}{F}^{3}\dot{T}t+\underline{F}^{3}\dot{T}t$. If we unite the magnesia and lime with the protoxide of iron, Mosander's numbers give the same formula.

KUPFERBLÜTHE.

This is a variety of red oxide of copper appearing in the form of capillary crystals, and found near Rheinbreitbach and Moldava.† They have been examined by Suckow, who found them to be pure suboxide of copper, in the form of regular six-sided prisms. Having thus the composition of common red oxide of copper, but belonging to a different system of crystallization, Suckow supposes them to constitute a peculiar species. Red oxide of copper is thus shown to be a dimorphous substance. There is also sometimes produced in the process of reducing copper ores, prismatic crystals, but of less definite form, which are manifestly composed of the same oxide.

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* Kong. Vet. Acad. Hand., 1829, p. 227.

† Berzelius' Rapport Annuel, 1836, p. 165.

LEUCHTENBERGITE.

M. Komonen. (*Trans. Imp. Min. Soc. of St. Petersburg*, 1842, p. 64.)

This mineral was given for examination by Major Jewreinoff. It occurs in large conglomerated, but not perfectly developed crystals, in the form of the rhombohedron. It is in masses and of a yellowish color, but in thin layers, white. Has a lamellar texture and pearly lustre. The smaller crystals are transparent. Specific gravity 2·71. Feels greasy, is cut with the knife, and receives impressions from the nail. Hardness between calc-spar and selenite. Fuses with phosphate of soda and ammonia into a bead, which, while hot, is of a weak bottle-green, but after cooling, colorless. In this bead, while cooling, an opalescence may be observed. With borax, it gives a transparent glass, which is colorless after cooling. With soda it imperfectly fuses into a cinder, but gives no transparent glass. Occurs in the Schischminsk mines in the district of Slatonst. Its analysis afforded M. Komonen the following results:

Silica	34·23
Alumina	16·31
Peroxide of iron	3·33
Lime	1·75
Magnesia	35·36
Water	8·68
	99·66

Formula by the Analyst: $6\dot{M}g\dddot{A}+7\dot{M}^3\dddot{S}i^2+9\dot{M}g\dot{H}^2$.

Major Jewreinoff proposed to name it Leuchtenbergite, in honor of his Imperial Highness, the Duke Maximilian of Leuchtenberg, a distinguished friend of the natural sciences.

NITRATE OF MERCURY.

A mineral which has been mistaken for white lead ore, but which appears to be nearly pure nitrate of mercury from Johann-Georgenstadt, has been examined by M. John. It is partly soluble in water, leaving a residuum of a substance which is first yellow, then green, and which is easily dissolved in nitrous acid. When heated in a glass tube red vapors of nitrous acid appear, while a bright yellow and red sublimate was exhibited, a very little red oxide remaining. Rammelsberg observes that repeated experiments must decide whether this mineral, which, at any rate, seems to be a secondary production, is pure nitrate of protoxide of mercury, as John has concluded from his experiments.—*Handwörterbuch*, ii. 88.

SODA-ALUM. From Bolivia.

It was obtained by Mr. Blake in the desert of Atacama, thirty miles north-east of the Indian village of Atacama, in small veins in feldspathic rock of volcanic origin, and in considerable quantity encrusting the surface of the soil. It is crystallyzed in minute plates; color white; lustre pearly; solution reddens litmus; dissolves readily in water, being more soluble than common alum, which in part it resembles. Its constituents, according to Mr. Blake, are as follow:

Alumina	18·000
Sulphuric acid	35·266
Soda	1·606
Chlorhydric acid	0·346
Water	42·666
	97·884

This salt agrees with the soda-alum from St. Juan, analyzed by Dr. Thomson, (see page 333), excepting in the smaller amount of its soda.

SULPHATE OF SODA AND MAGNESIA.

It was found by Mr. Blake in the northern part of Chili, in a ravine called Laventura, encrusting its bottom and sides. It is derived from a magnesian rock of volcanic origin, which yields it abundantly when digested with water, in which it is very soluble. Crystals in the form of *right square prisms.* Color white. Its solution reddens litmus. *About sixteen parts in one hundred, consist of sulphates of cobalt, manganese and alumina.*

B B, on platina wire with borax in O. F. it affords a bead, one portion of which is opake, and the other clear and of an amethyst color. In R. F. becomes semi-opake and assumes a blue tint. With phosphate of soda and ammonia in O. F. it affords a glass of an amethyst color. In R. F. becomes opake and deep blue. With soda, in O. F., affords an opake bead of a bright green color, which, in R. F., becomes pale flesh color.

JEFFERSONITE.

Dr. Thomson has analyzed the mineral called Jeffersonite, and obtained results so different from Keating, that he has assigned a new place to it in the system. It is a quadruple salt, and its constitution is thus expressed: $4CalS+4AlS+2FS^2+MgS^2$, proving it to differ essentially both from pyroxene and amphibole.—*Lond. Edinb. and Dub. Phil. Jour.*, xxii. 194, 1843.

ARSENICAL ANTIMONY.

Arsenik-Spiesglanz, L.

Its analysis gave these proportions of its elements:

Arsenic	62·15
Antimony	37·85
	100·00

It is constituted of three atoms arsenic, one atom antimony. Formula: $StAs^3$.

Sp. Gr. 6·2. H. = 2·0 — 4·0.

In kidney-shaped masses. Color tin-white. Occasionally splendent, sometimes dull. B B, it melts, and at the same time emits considerable fumes of arsenic and antimony.

This species was noticed by Zippe at Przibram in Bohemia, where it occurs in metallic veins, associated with blende, antimony, sparry iron, &c. It occurs also at Allemont.

ATELESTITE.

Shepard.

Heavy. H. about 3·0.

Crystalline, in structure resembling sphene. Color pure sulphur-yellow. Lustre between resinous and adamantine; transparent or translucent. B B, affords indications of bismuth.

Locality, Schneeberg in Saxony.

BATRACHITE.

Breithaupt.

Its constituents (*Rammelsberg's Handwörterbuch*, ii. 30,) are as follow:

Silica	37·69
Lime	35·45
Magnesia	21·79
Protoxide of iron	2·99
Water	1·27
	99·19

Formula by Rammelsberg:

$$\dot{C}a^3\dddot{S}i + \left.\begin{matrix} Mg^3 \\ \dot{F}e^3 \end{matrix}\right\} \dddot{S}i.$$

Sp. Gr. 3·038. H. = 5·0.

Massive, exhibiting traces of a Rhombic prism of 115°. Composition impalpable. Cleavage parallel to the sides and shorter diagonal of the prism, but mostly indistinct. Fracture small conchoidal. Color light greenish-grey, to almost white. Streak white. Lustre resinous or vitreous, more inclined to the latter. B B, *per se*, it is infusible, without any perceptible change of color to the flame. Heated in the matrass it affords a little moisture. It is slowly soluble in salt of phosphorus, leaving a silica residue; with soda it fuses with difficulty into a dark-colored pearl.

Is found at Rizoni, a mountain in Southern Tyrol.

BERZELINE.

Necker. (*Leonhard's Jahrbuch der Mineralogie*, ii. 441.)

H. about 5·0.

In extremely minute white octahedral crystals, whose surface is dull. Slightly translucent; and having a vitreous lustre on the fracture. Very brittle; but devoid of distinct cleavage. B B, in the forceps it is fusible, though with difficulty, into a pale glass. Forms with heated muriatic acid a greenish colored jelly.

From Galloro, near La Riccia, in the Roman States, where it accompanies crystals of black garnet and pinchbeck-brown mica, in the drusy cavities of an augitic rock.

BEUDANTITE.

Levy. (*Annals of Phil., new series*, xi. 195.)

H. = 4·0 — 4·5.

Occurs in small closely aggregated crystals, being slightly obtuse rhombs (viz. 92° 30′) with the summits truncated. Color black. Translucent in thin fragments, and of a deep-brown color by transmitted light. Lustre resinous. Streak greenish-grey. Cleavage easily effected perpendicular to the axis of the rhomb. The only substances Dr. Wollaston could detect in it were the oxides of lead and iron.

Beudantite is found associated with brown iron ore at Horhausen, in the district of Nassau, on the Rhine.*

BIOTINE.

Biotina, *Monticelli.* (*Mineralogia Vesuviana*, p. 438.) Biotin, *Leonhard.*

Sp. Gr. 3·11. Scratches glass.

Color white or yellowish. Transparent and limpid. Lustre brilliant. Fracture vitreous, inclining to conchoidal. Presents double refraction. Is not affected by the blowpipe, and is only partly soluble in nitric acid. Sig. Monticelli noticed this mineral among the volcanic debris of Vesuvius, and nam it in honor of M. Biot. It is easily distinguished from oth species with which it is associated, by the superior brillian of its lustre.

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* The Beudantite of Monticelli and Covelli, is now identified with Nepheline.

BREISLAKITE.

Occurs in delicate capillary prismatic crystals of a reddi or chesnut-brown color, coating the cavities of certain lav Its fibres are flexible, its lustre semi-metallic. It contai silica, alumina, iron, and a considerable proportion of copp B B, *per se*, it fuses readily into a brilliant and magne black scoria; with borax forms a green glass, which becom colorless in cooling; and with salt of phosphorus a gre globule, which reddens in the reducing flame. It accomp nies nepheline, pyroxene, and other Vesuvian minerals; a is met with both at that locality, and at Capo di Bove ne Rome.—*Allan's Manual.*

CHONIKRITE.

Von Kobell. (*J. f. pr. Chem.*, ii. 51.)

Hydro-silicate of alumina, magnesia, and lime. Constit ents, according to Von Kobell:

Silica	35·69
Alumina	17 12
Magnesia	22·50
Lime	12·00
Protoxide of iron	1·46
Water	9·00
	97·77

Formula by Rammelsberg.—(*Handwörterbuch*, ii. 311):· $3(\dot{\text{Mg}}, \dot{\text{Ca}})^3\dddot{\text{Si}}+\dddot{\bar{\text{Al}}}^2\dddot{\text{Si}}+6\dot{\bar{\text{H}}}$.

II. between 2·0 and 4·0.

Occurs massive. Composition impalpable. Fracture u even and imperfectly conchoidal. Lustre glimmering or dul Color white, with shades of yellow and grey. Transluce often only on the edges. Is not cleavable. B B, it fuses = 3½ to 4, with evolution of air bubbles, into a greyish-glas and with borax fuses slowly into a globule colored by iron. I is easily decomposed by concentrated muriatic acid.

Occurs in rounded masses at Elba.

SELENIURET OF PALLADIUM.

This mineral, described at page 516 as a new species, i now acknowledged by M. Zinken to be only Native Palladium —*Rammelsberg's Handwörterbuch*, ii. 135.

DERMATINE.

Breithaupt.

Its analysis, by Ficinus, gave the following constituents:

Silica	35·800
Magnesia	23·700
Protoxide of iron	11·333
Ptotoxide of manganese	2·250
Alumina	0·416
Lime	0·833
Water and carbonic acid	25·200
	100·033

Formula, deduced from these numbers by Von Kobell: $\dot{M}g^2\dddot{S}i+4\dot{H}$.

Sp. Gr. 2·136. H. about 2·0.

In reniform masses, rarely globular, and in thin coatings or crusts. Color dark olive-green or liver-brown; with low resinous lustre. Translucent on the edges. Fracture conchoidal. Feels greasy, and does not attach itself to the moist lip. Streak yellow, inclining to grey. Emits an argillaceous odor when breathed upon. Splits and becomes somewhat friable B B, assuming at the same time a darker hue.

From the serpentine quarry near Waldheim in Saxony.

GREEN IRON EARTH.

Grüne Eisenerde, W. Hypochlorite, *Schüler*.

Contains oxide of bismuth 13·03, silica 50·24, alumina 14·65, oxide of iron 10·54, phosphoric acid, with traces of manganese, 9·62. — *Schüler*.

Occurs in reniform, botryoidal, and globular masses; structure impalpable; color siskin-green, passing into black and yellow; lustre resinous and dull; streak yellowish-grey; brittle; becomes brown and black, B B, but does not melt; nor is it soluble in nitric acid. Is found at Schneeberg in Saxony, and in the county of Sayn in Germany.

MARCELINE.

Beudant. Silicate of Manganese from Piedmont. — *Berzelius.*

Sp. Gr. 3·8. Scarcely scratches glass.

A silicate of deutoxide of manganese, without water.

Silica	15·17	26·00
Oxide of manganese	75·80	67·23
Oxide of iron	4 14	1·23
Alumina	2·80	3·00
Lime	0·00	1·40
Magnesia	0·00	1·40
	97·91 Berzelius.	100·26 Berthier.

Occurs crystallized in octahedrons, with a square base. Color greyish-black, with a slightly metallic or vitreous lustre; yields no water when calcined; is fusible B B, withou alteration of color, imparting to soda a distinct re-action o the oxide of manganese. Is acted upon by muriatic acid, wit disengagement of chlorine, leaving a gelatinous residue.

Marceline forms considerable repositories in mica-schist, i the valley of Saint Marcel in Piedmont.

MONTICELLITE.

Brooke. (*Annals of Philosophy*, Oct. 1831.)

H. $=5{\cdot}0-6{\cdot}0$.

In small imbedded crystals, having the general aspect o quartz. Color yellowish; sometimes nearly transparent, an colorless.

Occurs at Vesuvius imbedded in a crystalline carbonate o lime, along with particles of black mica and minute crystals o pyroxene. Its name was proposed by Brooke, in honor o the celebrated Neapolitan mineralogist Monticelli.

NONTRONITE.

Berthier. (*Ann. de Chim. et de Phys.*, xxxv. 92.)

Contains silica 44·0, peroxide of iron 29·0, alumina 3·6 magnesia 2·1, water 18·7, clay 1·2. —*Berthier.*

This substance resembles clay. It is of a pale straw, or canary-yellow color, with a greenish tinge. Opake. Unctuou to the touch; and exhaling an odor when breathed upon Acquires a fine polish and resinous lustre from the friction o softer bodies. Is not reduced to powder, but becomes lump under the pestle; and does not affect the magnet. When immersed in water it disengages numerous air bubbles, become translucent on the edges, and increases in weight. Whe slightly heated, it gives off water, and assumes the color o red oxide of iron; and when calcined becomes sensibly magnetic.

Nontronite was noticed by Berthier in small kidney-shaped masses among manganese in the arrondissement of Nontron in France.

PROTHEITE.

Ure.

Heavy. Scratches glass.

In rectangular prisms, the faces being striated longitudinal ly. Color olive-green or white. Nearly opake in large specimens, translucent in smaller Lustre vitreous, inclining to adamantine. Is infusible B B, and becomes electric by friction.

Has lately been discovered in the Zillerthal in the Tyrol.

STEINMANNITE.

Zippe.

Sp. Gr. 6·833. H. = 2·5.

Primary form the Cube. Secondary form the regular octahedron.

Cleavage parallel to the cube, imperfect and scarcely visible. Fracture uneven. Surface of the crystals smooth. Lustre metallic. Color pure lead grey. Botryoidal; massive. Composition fine granular; in some varieties a curved lamellar composition is visible. Composition also compact, sometimes porous. When heated B B, on charcoal, it decrepitates with violence. Its powder, heated, emits the odor of sulphurous acid, and a metallic globule remains, as in the case of galena, but which finally yields a distinct button of silver. It appears to consist of lead, antimony, silver, and sulphur.

It is found at Przibram with quartz, blende, and iron pyrites.

STILPNOMELAN.

(*Glocker. Mineralogie*, p. 391.)

It has been analyzed by Rammelsberg, (*Handwörterbuch*, ii. 186,) who obtained the following results.

Silica	46·500
Protoxide of iron	33·892
Alumina	7·100
Lime	0·197
Magnesia	1·888
Water	7·900
	97·477

The formula, by Rammelsberg: $2\dot{F}e^3\dddot{S}i^2+\dddot{A}l\dddot{S}i^2+6\dot{H}$.

Sp. Gr. 3·27 — 3·4. H. = 3·0 — 4·0.

In crystalline, lamellar, and fibrous masses, of a black or greenish color; lustre vitreous; cleavage in one direction; streak olive-green to liver-brown. Insoluble in acids; fusible B B, into a bluish-black scoria which shows the presence of iron.

Localities, Obergrund and Zinkmantel in Silesia.

SYLVYNE.

Beudant. (Traité, t. ii. 511.) Muriate of Potash. Chlorure de Potassium.

Consists of chlorine 47·46, potassium 52·54.

Formula: $KChl^2$.

Soluble, with the taste of common salt. Crystallizes in th form of the Cube, and cleaves parallel to the faces of that soli When in solution the addition of muriate of platina produc a yellow precipitate. Treated with sulphuric acid, it leave after evaporation, acicular crystals, which do not effloresce i the air.

It is found in small quantity, mixed with salt, in the mine of Hallein and Berchtesgaden, in Saltzburg, where it was fir noticed by M. Vogel.

TEPHROITE.

Breithaupt.

Sp. Gr. 4·116. H. = 5·0 — 6·0.

Massive and compact. Color ash-grey, tarnishing blac Lustre adamantine. Streak somewhat paler than the minera Cleavage perfect in several directions; two of them formin together a right angle. Fracture imperfect conchoidal, or un even. Forms a black slag B B.

Occurs with Franklinite and red oxide of zinc, at Sparta Sussex county, New Jersey. The distinctive characters o this mineral are so imperfectly made out that America mineralogists have not been able to identify it. Shepard supposes it to be a variety of Troostite.

ZURLITE.*

Monticelli.

Sp. Gr. 3·27. H. about 6·0.

Occurs in rectangular four-sided prisms, lengthened in the direction of their axes, and having occasionally their lateral edges replaced. Color asparagus-green, inclining to grey. Opake. Lustre resinous. Cleavage indistinct. Fracture conchoidal. Surface of the crystals rough, frequently covered with a white coating. It is infusible B B, but yields with borax a black glass. Nitric acid dissolves it, partly with effervescence, and the solution becomes yellow. Zurlite is a Vesuvian mineral; it is generally found in large distinct crystals, associated with calc spar and other species.

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* In compliment to the Neapolitan minister, Sig. Zurlo.

VARGASITE.

A mineral of a pale-greenish color, found in Finland, usually in amorphous masses of a columnar structure, and named in honor of Count Vargas de Bedemar, in justice to whom some more particular description of the mineral should be drawn up and published, or the name be applied to some species of a less doubtful character.

HAYDENITE.

We are indebted to Mr. B. Silliman, Jr., (communication to the editor) for an analysis of this mineral, which, in its physical and crystallographical characters, has been described at page 123. His results exclude it entirely from the formula for chabasie, with which some had supposed it to be identical, as it contains only one-third of the quantity of water, and a much larger proportion of silicic acid, which forms a tersilicate with the alumina; the latter, if we include with it the isomorphous peroxide of iron, nearly agreeing with Al. in chabasie. Joined with M. Lévy's investigations, they fully establish its claims as a distinct species. The following are his results—the excess probably being water:

		Atoms.	
Silica	56·831	28·41	7
Alumina	12·345	5·48	2
Peroxide of iron	8·035	1·60	
Potash	2·388	0·40	1
Lime	8·419	2·40	
Magnesia	3·960	1·13	
Water	8·905	7·91	2
	100·883		

The formula answering to these numbers (admitting a slight deficiency in the Al. and $\underset{\cdot}{F}$) may be thus stated: $2(\bar{Al},\underset{\cdot}{F})S^3+(K, Cal, Mg,)S+(2Aq?)$

GREENOVITE.

TITANIATE OF MANGANESE.

M. Dufrénoy* has given this name, in honor of G. B. Greenough, Esq., to a mineral from St. Marcel in Piedmont, which had been supposed to be a silicate of manganese, but is, in fact, a titaniate of manganese, and, except Crichtonite, which is a titaniate of iron, it is the only titaniate hitherto described. The proportions of its constituents, as determined by M. Cacarrié, are: titanic acid 74·5, oxide of manganese 24·8, lime† 0·0 = 99·3.

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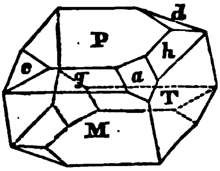
* Annales des Mines, t. xvii. p. 529. Lond. Edinb. and Dub. Phil. Mag., xxi. 246, 1842.

† An accident prevented the quantity of lime from being determined, but it could not have amounted to one per cent.

These numbers correspond very nearly with three ato titanic acid, and one atom oxide of manganese. Formu $\text{Mn}\dot{\text{T}}\text{t}^3$.

As described by M. Dufrénoy, it occurs in small, amorpho crystalline masses, is of a deep rose color, and has the speci gravity 3·44. Hardness greater than that of fluor spar, phosphate of lime, but it does not scratch glass. It is n acted upon by acids, nor is it fusible, *per se*, by the blowpi With microcosmic salt, it shows the reaction of titanium; a with soda that of manganese. The crystals are brilliant, e pecially on the faces M and T; the terminal faces being oft dull and tarnished. The primary form is a Doubly obliq prism, which presents the modifications shown by the followi figure. The angles were determined by actual observatio and partly by calculation.



P on M	87°	10′
P on T	85	50
M on T	110	35
a on M	119	20
a on T	118	10
a on P	140	06
c on M	107	50

c on T	83°
c on P	153
d on T	106
d on *a*	146
g on T	110
g on P	155
h on P	112?

This mineral was discovered by M. Bertrand-de-Lom wi other ores of manganese, in irregular rose-colored veins, a companied by quartz, epidote and manganese.

LEONHARDITE.

This mineral very much resembles Laumonite in its exte nal characters, and its property of decomposing by loss of i water, under the ordinary temperature of the atmosphere. B in its analysis, it is shown to be distinct from true Laumonit Dr. Delff found it composed as follows:

Silica	56·128
Alumina	22·980
Lime	9·251
Water and loss	11·641
	100·000

Sp. Gr. 2·25. H. = 3 — 3·5.

Color white, passing into yellow, and more rarely, into brown ish. Frequently coated with brownish or black powder. Streak white. Translucent on the edges. Lustre pearly, especiall on perfect cleavage planes; on the fractured surface vitreous Primary form, an Oblique rhombic prism; M on M 96° 30′ and 83° 30′, P on M 114° and 64°. This is the only form observed.

The prismatic crystals are frequently aggregated together, so that a large individual is composed of several smaller ones. The lateral planes are streaked in a direction parallel to the principal axis; two of them are often larger than the others. Sometimes crystalline columnar, and granular masses occur. Cleavage very perfect, parallel to the lateral planes, imperfect in the directions of P. Fracture uneven. Pyrognostic characters not given. This mineral occurs near Wolfstein, in Rhenish Bavaria, also in the neighborhood of Heidelnberg. It has been examined both by Dr. Delff and Prof. Blum, and named by them in honor of Von Leonhard.

WÖHLERITE.*

Under this name, given in honor of Professor Wöhler, Scheerer of Christiania, has described a substance found on one of the islands of the Largesund-Fjord, near Brevig, in Norway. It occurs also in the island of Lövöe, in Zircon-sienite, accompanied by eaolite, zircon and pyrochlore.

Its analysis by Scheerer, gave the following results:

Silica	30·62
Tantalic acid	14·47
Zirconia	15·17
Oxide of iron	2·12
Protoxide of manganese	1·55
Lime	26·19
Soda	7·78
Magnesia	0·40
Water	0·24
	98·54

Formula: $\dddot{\cancel{\mathrm{Z}}}\mathrm{r}^3\dddot{\mathrm{T}}\mathrm{a}+5(\dot{\mathrm{N}}\mathrm{a}, \dddot{\mathrm{Si}}+\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{Si}})$.

Sp. Gr. 3·41. H. = between felspar and apatite.

It occurs in angular grains, and rarely in broad, prismatic or tabular crystals; of which, however, no exact crystallographical description has been given, as their faces are imperfectly developed, and it is difficult to separate them from the surrounding mass. Indications of cleavage observed in one direction. The color is yellow, of various shades, passing into brownish, viz: light-yellow, wine-yellow, honey-yellow, brownish-yellow. Color of the powder, yellowish-white. Its transparency varies as much as in zircon. The crystalline faces exhibit a vitreous lustre. Fracture more or less conchoidal, sometimes passing into splintery and granular. Characters B B, not stated.

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*This, and the preceding article, have been abridged from Prof. Jameson's Phil. Jour. for Oct., 1843, into which they had been copied from Poggendorf's Annalen, lix. 1843.

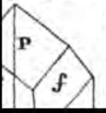
GLAUBERITE.

his mineral was among the specimens brought b e, from the Province of Tarapaca, in Peru. Fr titive examination, Mr. Hayes ascertained that it cont uric acid, soda and lime. He afterwards submitte sis, and found it to be identical with Glauberite. It the following results:

			Ratio.
Sulphuric acid	57·220	11·44	2
Soda	21·324	5·33	1
Lime	20·680	5·90	1
Protoxide of iron	·444		
	99·668		

here is a slight deficiency in the quantity of soda, salt evidently consists of one atom sulphate of soda sulphate of lime. This is the composition of the v Villa Rubia, in Spain, originally analyzed by Brong nula: $N\dot{S}l+Cal\dot{S}l$, or as stated by Mr. Hayes: (N $CaO, SO^3.)=\dot{N}a\dddot{S}+\dot{C}a\dddot{S}$.

occurs in extremely brilliant, colorless and transp als, imbedded in hydrated borate of lime, or Hay are in the form of elongated oblique rhombic pr ly replaced on their obtuse terminal edges, by single pl



Mr. Teschemacher, who has given the an figure of one of these crystals, has also mea their angles with the reflecting goniometer determined their exact agreement with rose-red or light-green. Compact, but easily divided parallel with the fibres; brittle. Specific Gravity 1·78 to 1·80. It swells when heated, and the white mass which remains tastes like alum. Its analysis afforded Mr. A. A. Hayes, the following results:

Water of crystallization	45·450
Sulphuric acid	36·322
Alumina	12·130
Magnesia	4·682
Protoxides of manganese and iron	0·430
Lime	0·126
Muriatic acid	0·604
	99·744

This mineral appears to be a very pure native magnesian alum, and very nearly answers to the composition of a magnesian alum from South Africa, analyzed by Stromeyer, whose results are thus stated *(Ramm. Handwörterbuch*, i. 9*)*: sulphuric acid 36·770, alumina 11·515, magnesia 3·690, peroxide of manganese 2·617, water 45·739, chloride of potassium 0·205 = 100·086. The formula, as determined by Mr. Hayes, is: $\mathrm{Mg}\dddot{\mathrm{S}}+\dot{\mathrm{A}}\mathrm{l}\dddot{\mathrm{S}}^{3}+22\dot{\mathrm{H}}$, which differs only slightly in the last term from the formula given by Rammelsberg.

A specimen of the same mineral which had been sent by the editor to Dr. Thomson, of Glasgow, has afforded, in the hands of this chemist, very different results, as thus stated *(Lond. Edinb. and Dub. Phil. Mag.*, xxii. 192, 1843,*)*: sulphuric acid 32·95, alumina 22·55, sulphate of soda 6·50, water 39·20 =101·02. As viewed by Dr. Thomson, it is a *subsesquisulphate* of alumina, consisting of 1 At. $\dot{\mathrm{S}}\mathrm{l}$, 1½ At. Al, 1 At. $\mathrm{N}\dot{\mathrm{S}}\mathrm{l}$, 5 At. Aq. It is evident that the soda must exist in this mineral, without producing any change in its physical characters, because these characters are alike stated both by Dr. Thomson and Mr. Hayes, and the specimen sent to Dr. Thomson could not be distinguished from the other masses brought to us by Mr. Blake.

It occurs abundantly in the Province of Tarapaca in Peru, associated with Glauberite, hydro-borate of lime, and *iodate of soda*, hydriodate of soda, sulphate and biborate of soda, chloride of sodium, and organic matter.

IODATE OF SODA.

This remarkable mineral forms a considerable proportion of the saline mixtures, associated with borate of lime, and was first detected by Mr. Hayes, in his examinations of the last named substance. He has also found it with the native nitrate of soda, from Peru, intermixed with various other saline substances.

MONRADITE.*

A. Erdmann has described a new mineral from the dioces Bergen, which he calls Monradite, after the late apotheca Monrad. It is yellow, of a pale color, somewhat inclining reddish, compact and sprinkled with mica, but has a deteri nate crystalline structure, with cleavage planes inclining to ea other at 130°; strong vitreous lustre; surface here and th striated; cross-fracture fine grained and close. Specific gr ity 3·2673. H. nearly that of felspar. B B, it does not fu but gives water and darkens a little. Dissolves in borax i an iron-colored glass, which, with much addition, becomes t bid in cooling. Dissolves by phosphoric salts, leaving a sk eton of silica. With little soda it melts into a turbid gre ish-pearl; with more it forms an infusible slag. It is co posed of silica 56·17, magnesia 31·63, protoxide of iron 8· water 4·04. Formula: $4(\mathrm{Mg},\underline{\mathrm{F}})\mathrm{S}^2+\mathrm{Aq}$. This adds anot species to the several native combinations of bisilicate of m nesia previously known.

RODOCHROM.†

This mineral was first brought from Siberia, by Fiedler. is a dark-green serpentine-like mineral, containing chromiu and he called it Rodochrom. It has lately been described G. Rose. It occurs partly in loose stones, partly imbedded serpentine, between Kyschtimsk and Syssersh, in Ural. I compact, sometimes in fine scales, and of a dark-green. T fine splinters are of a peach-bloom color. It gives a whit powder; on fracture it has a pearly lustre; is transparent on t edges; scratched by calc-spar. Specific gravity 2·668. Heat much it becomes gray-white and gives water; fuses slowly thin edges into a yellow enamel; is dissolved in borax and pho phoric salts into chrome-green glass; gives with the latter silica skeleton. With soda fuses into a yellowish-opake ma Heated with cobalt solution, the powder becomes white. Ro compared it with serpentine, from which it differs chiefly the chrome. The blue color with cobalt seems, however, betoken more clay than would be consistent with a serpenti nature; and its fusibility with soda is different from wh would happen with a serpentine.

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* Berzelius; Arsberättelse, for 1843, p. 195.

† Berzelius; Arsb., p. 212.

KÄMMERERITE.

Berzelius, in his Annual Report for 1843, (Arsb. p. 193,) has noticed this mineral, (already described at page 115 of this volume,) and has given us its mineralogical formula from Hartwall's analysis; $2MgS+(AlCr)S+2Aq$. He observes that it much resembles the Hydrargillite from Achmatowsk, described by G. Rose; but acts differently B B. At the same time, its composition agrees with Von Kobell's Pyrosclerite, though it differs from it in several external particulars.

VANADATE OF LIME.*

Ficinus has discovered this rare mineral in the form of tile-red lamenated masses of a brilliant lustre, associated with pitchblende; locality not stated. It dissolves in nitric acid, and leaves no residuum. Carbonate of soda precipitates from it carbonate of lime, and salamoniac dissolved in the remaining solution, precipitates flocculi of vanadate of ammonia. Berzelius supposes that, from the intermixture of this mineral, may proceed the vanadium contained in vanadic pitch-blende.

BROWN MAGNESIAN MICA.

The brown mica from Jefferson county, New York, has recently been analyzed by Meitzendorff, whose average results are thus stated by Berzelius, (Arsb., 1843, p. 211,) silica 41·30, alumina 15·35, pertoxide of iron 1·77, magnesia 28·79, potash 9·70, soda 0·65, fluóric acid 3·30, loss by ignition 0·28. It thus agrees very nearly with Prof. H. Rose's analysis of a Siberian magnesia mica, mentioned at p. 179. The formula added is: $KFl+9MgS+6AlS$.

HYDROFITE.

M. Svanberg. (*Trans. Swedish Roy. Acad.* 1839, *p.* 186.)

The slags obtained from the cast iron, made from the ores which are found at Taberg in Smaland, Sweden, having been examined by Sefström, and found to contain vanadium, it became important to ascertain the nature of the mineral contained in those ores from which this metal was derived. We are now indebted to M. Svanberg for this information. It occurs with pikrolite, in compact or fibrous masses, with an uneven fracture, and of a mountain-green color. Streak lighter;

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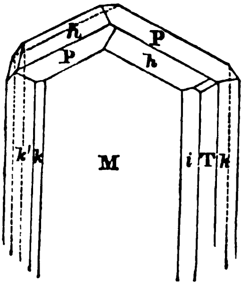
* Berzelius; Arsb., 1843, p. 196.

hardness between calc-spar and fluor-spar; specific gravit 2·65. B B, it gives off water, and seems perfectly infusibl even in the thinnest splinters. Its analysis afforded very nea ly the same results as serpentine, from which it differs in havin a considerable portion of protoxide of iron in the place magnesia; in containing a little more water, and having combination with it a very small quantity of vanadic acid.

FELSPAR.

The American localities of this species having been omitt in the body of the work, are here introduced. The fine crystallized forms accompany zircon and phosphate of lime white limestone, at Hammond, St. Lawrence county, N. They are in thin tabular crystals, both single and macled, a occasionally from three to four inches in diameter. External in color and appearance, they resemble horn, but on fractu and cleavage, they are nearly pure white, of a vitreous lust and slightly opalescent. More rarely they are iridescent, a susceptible of much beauty by polishing. One of the modi cations is a figure very similar to that given under the speci felspar in this volume, (the *synoptique* of Haüy) produced the replacement of the lateral solid angles E, of the obtu terminal edges D and F, (see fig. 13, of the Introduction, xi,) and of the oblique and lateral edges of the prism by si gle planes. The annexed figure, drawn from a very perfe smooth planed crystal in the editor possession, represents one of the sin plest of the twin forms from this l cality. Interesting crystals are foun with the chrysoberyls, at Greenfiel Saratoga county, N. Y., also in Orang Essex, and Lewis counties. Very sin gular twin crystals were found by D Horton, at Harlem, near New Yor city, in fissures of gneiss; and Pro Beck has given figures of several inter esting forms, in his Report on th Mineralogy of New York. In Bucks and Chester counties Penn., it occurs crystallized, and in cleavable masses, some times passing into transparent Adularia. At Jones Falls Maryland, both green felspar, and Adularia, the latter pure white and reflecting a blue light, occur in granite. In Connecticut the china-stone quarries at Middleton, have furnished very large crystals, sometimes a foot in length in the direction of the edges



formed by the meeting of the planes P and M, while very perfect crystals of inferior size, mentioned by Prof. Shepard, are found at Litchfield, as also the sun-stone at Lynn, Adularia at the Falls of the Yantic, in Norwich, and a green variety at Bolton, in the same State. At Royalston and Barre, Mass., a beautiful pure white massive variety, and sometimes crystallized, is found with beryls and mica. It occurs under similar circumstances, at Acworth, N. H., and at Paris, Me. Small crystals, according to Prof. Cleaveland, are found in the granite at Freeport and Brunswick, Me., as well as the green variety at Topsham, Me. But the deep rich green felspar, from Beverly, Mass., discovered and analyzed by Prof. J. W. Webster, far surpasses any other variety of this mineral hitherto observed in the United States. Prof. Webster found its composition as here stated: silica 72, alumina 10·1, lime 1·2, magnesia 3·2, peroxide of iron 2, potash 11·1, with a trace of chrome.* It contains more silica, and less alumina, than the Siberian green felspar, analyzed by Vauquelin, but about the same proportion of potash. If we unite the peroxide of iron and alumina, it comes nearer to the analysis of a specimen by Klaproth, which gave silica 70, alumina 16·50, potash 11·50.

GREENOCKITE.

The papers of Prof. Jameson, and Arthur Connell, Esq.,† have enabled me to supply one or two important facts relating to this rare and interesting substance, mentioned at page 573. It is readily distinguished from zinc-blende by its reactions. Owing to its decrepitating property, it is difficult to act on it *per se* on charcoal; but when this can be accomplished, the usual yellowish-red ring, arising from the oxidation of sublimated cadmium, is formed around the fragment. When mixed with soda and acted on, on charcoal, this ring continues to be formed to the last, without any of the white sublimate which zinc-blende affords. With borax it yields a transparent yellow glass. Heated in a glass tube, it decrepitates and acquires a fine carmine-red color, but on cooling recovers its yellow tint. At a red heat, it does not fuse nor volatilize. In powder, it is readily soluble in heated hydrochloric acid, with strong odor of sulphydric acid gas. Carbonate of soda causes a white precipitate, soluble in ammonia. The muriatic solution, by evaporation, afforded a white prismatic crystallization, not de quescing in an ordinary atmosphere. This character disti guishes this mineral from zinc-blende.

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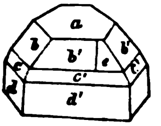
* Boston Journal of Philosophy and the Arts, i. 390.

† Edinburgh Philosophical Journal, xxviii. 391.

The crystals are short six-sided prisms, as already describ the faces of the acute pyramids, by which they are terminate are transversely streaked. The measurements and figure, ha



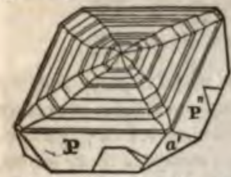
been supplied by Brooke: *a* on *b* 136° 40′; on *c* 118°; *a* on *d* 90°; *b* on *e* about 17 He obtained an apparent cleavage parall with the lateral planes *d*, but was unable determine satisfactorily the primary form, to decide whether they were any more than planes of co position of other intersecting crystals. He says, "the fo appears to be a regular six-sided prism, but I suspect that it derived, like sulphate of potash, from the intersection of th rhombic prisms." More recently, Prof. Jameson observ that "the examination of some additional specimens lea little doubt that the mineral belongs to the rhombohedral s tem of crystallization."—*Journ.*, xxix. 175.

RHODIZITE.

It was mentioned at page 318, that the mineral there nam borocalcite, was the only native borate of lime known. was not then known to the editor, that Prof. G. Rose had ma a qualitative examination of some crystals found on the r Siberian tourmaline, which proved to be borate of lim though evidently a more basic compound than the borocalcit On account of its rarity, it has not been quantitatively exami ed. Its behavior B B, is thus stated by Rose. (*Ramme berg's Handwörterbuch*, ii. 102.) Slowly fusible on the edges i to a white-opake glass, which throws out excrescences, that shi very strongly with a yellowish-red light. It colors the flan first green on one part, then red on another, and finally r throughout. On charcoal it rounds off only on the edges, an becomes snow-white and opake. In alembic gives no wate With borax and phosphoric salt, it dissolves into a clear glas fuses with fluor spar into a clear glass; with little soda into white enamel; and with addition of soda into a colorless glas This glass, triturated and decomposed by hydrochloric aci communicates a green color to alcohol, with which the res duum is washed after the solution is evaporated to dryness.

SULPHURET OF LEAD FROM ROSSIE, N. Y.

The crystals of galena from Rossie, which present all the usual modifications of this substance, are sometimes most singularly constituted. The annexed figure, represents one of the natural size, in the editor's possession. It is a flattened cube. The lateral planes P P′, as well as the replacements of the lower solid angles *a a′*, are extremely brilliant and regular; but the upper solid angles, and the terminal edges, are replaced by planes which successively rise, in a step-like manner, to the apex, forming a very low pyramid. These replacements are eleven in number, on each face of the pyramid, and the lines which connect them with each other, meet exactly at the same point; thus dividing them into a regular series of parallel faces, having nearly the same relative dimensions throughout. It is not easy to give a satisfactory explanation of the origin of this crystal, and others like it, but the faces bear marks of having undergone fusion, (as is the case also with many of the ordinary crystals of galena, as well as of the phosphate of lime, quartz and felspar, from the same vicinity,) since their original deposition; and it is not improbable, that the phenomenon may have had a connection with this circumstance. It would appear that the pyramidal face was downward, and that the molecules, having their cohesion gradually overcome, but not sufficiently so to separate themselves entirely from the mass, and while yet subject to the law of crystallization, subsided in the manner in which we now see them. An appearance somewhat similar to this, has been observed among artificial crystals produced by heat, particularly in crystals of lead, obtained in the manner of crystallizing bismuth.



The similar appearances on the crystals of quartz, from Grafton, N. H., first noticed and described by Mr. Teschemacher, appear to be owing to the intersection of laminæ of mica, with which they occur, as they correspond with the angles of mica, and are supposed to have no connection with the crystalline form of quartz.

MELLILITE, IDENTICAL WITH HUMBOLDILITE.

M. Damour (*Ann. de Chim. et de Phys.* 3d *Ser., Jan.*, 1844,) has established the identity of these two minerals by a comparison of their general physical characters, and the institution of new analyses. His results are as here stated; the two first being of Mellilite, and the last of Humboldilite.

	Pale yellow crystals.	Brown crystals.	Humboldtilite.
Silica	39·22	38·34	40·89
Lime	32·47	32·15	31·81
Magnesia	6·44	6·71	5·75
Potash	1·46	1·51	0·36
Soda	1·95	2·12	4·43
Peroxide of iron	10·07	10·02	10·68
Alumina	6·42	8·61	4·43
	98·18	99·36	98·35

The analysis of the two first differs widely from that Carpi, given at page 69, while the latter agrees almost precis with Von Kobell's analysis of Humboldilite, stated at page 21. Owing to the discrepancy between the two analyses there give the formula was omitted.' The mineralogical formula now deducible from these results, is: $2(\text{Cal, Mg, K, N,})\text{S}+(\text{Al,F})\text{S}$

BEUDANDITE.

According to MM. Damour and Descloizeaux, (*Ann. de Chim. et de Phys.* 3d *Ser.*, *Jan.*, 1844, pp. 72, 77,) the Beudandite of Lévy proves to be identical with pharmacoderite from Cornwall. The oxide of lead, which Dr. Wollaston detected in it, is shown to be an accidental mixture. Another substance should therefore be dedicated to that distinguished author. One may ask, how many of Lévy's new minerals are destined to stand the scrutiny of later observers?

STELLITE, OR ANHYDROUS LIME-MESOLITE.

Stellite and Anhydrous Zeolite, from Bergen, N. J.

Prof. Beck, in his *Report on the Mineralogy of New York* page 343, has given the analysis of a radiated, trappean minera from Bergen, N. J., which he supposes may be identical wit the stellite of Dr. Thomson. He obtained of silica 54·60 lime 33·65, magnesia 6·80, oxide of iron and alumina 0·50 water and carbonic acid 3·20

It thus differs from Dr. Thomson's mineral, principally i the smaller amount of its alumina and water; but it consist of four atoms bisilicate of lime, and one atom bisilicate o magnesia. The physical characters, also, so far as they hav been examined, favor Dr. Beck's views of their identity.

At the editor's request, Mr. Hayes has analyzed the same stellular substance, which consisted of tufts of sharp needle-form crystals, proceeding from a compact centre, and terminating a their free extremities, by regular four-sided pyramids. His results, as given in a note to page 205, are here repeated; silic 59·96, lime 39·72, soda 6·75, potash 0·60, protoxide of manga nese 0·64, alumina 0·08, hygrometric water 0·16 Divided by the atomic weights, and reckoning together the potash and soda, the constitution of this mineral appears to be very nearly 6 atoms bisilicate of lime, and one atom quatersilicate of potash and soda. Formula: $6\mathrm{CalS}^2+(\mathrm{K}, \mathrm{N},)\mathrm{S}^4$. This result is very remarkable, as it proves the mineral to be an *anhydrous silicate*, and, therefore, unlike any of the zeolite species which have hitherto been met with in the trap rocks of the United States. Specific gravity, according to Beck, 2·836. Its hardness is equal to that of glass. Mr. Hayes has thus given its characters, B B. In the outer flame, it whitens and becomes opake; at a higher temperature, it fuses with slight bubbling into a white enamel. In the reducing flame, the globule shines brilliantly and becomes almost transparent on cooling. The yellow color of the flame shows the presence of soda. With its bulk of soda, the mineral gives a slag, which, in the outer flame, has a green color; in the reducing flame, a flesh-red color takes its place.

It will be observed that there is a very close resemblance in composition and general physical characters, between this mineral and three others, — the Wollastonite and Stellite of Dr. Thomson, and the Pektolite of Von Kobell, (See pp. 69. 121. 238,) excepting in its entire freedom from water, and its more perfect crystallization; the alumina in the stellite being accidental, while the magnesia takes the place of the alkalies, the water in all of them, probably varying as an accidental mixture. They undoubtedly all constitute but one species, and while they may be most appropriately designated under the name of Stellite, the chemical title of *anhydrous lime-mesolite* is naturally suggested by their crystallographical identity with mesolite, as established by Mr. Teschemacher, who received from the editor a few of the most perfect crystals, presenting precisely the same modifications with mesolite, with the request that he would measure and compare them with mesolite. These crystals were from the Bergen locality, and from the same specimen with those analyzed. But mesolite consists of three atoms silicate of alumina, one atom tersilicate of lime and soda, while the foreign anhydrous mineral, consists of four atoms bisilicate of lime, and one atom tersilicate of soda, and potash.

PYRRHITE.

This exceedingly rare and beautiful mineral, hitherto found only in Siberia, and of which but a single specimen comprising eight crystals, is known to mineralogists, has been recognised among the interesting substances recently brought from Azores, by Prof. J. W. Webster. The specimen was placed Mr. Teschemacher's hands for examination by Prof. Webster, and was supposed, by both of these gentlemen, to be a new substance. On comparing it with pyrrhite, as described on page 176, Mr. Teschemacher was at once convinced of its identity with that substance. He has furnished the following description. Form, beautifully perfect regular octahedrons; color, deep orange-yellow; transparent on the edges, with a brilliant vitreous lustre. Hardness equal to that of felspar. The crystals are from one-half to two lines in length, and they are super-imposed on a white felspar, or albite. The minute crystals are quite transparent. One of these exposed to the oxidating flame of the blowpipe, became opake, retaining its orange color, but duller. Changed to the reducing flame, it melted without frothing, and assumed a deep, dull indigo-blue color, which could only be distinguished from black in a bright light, and on the minute edges of the fused crystal. With borax, it melts into a dark brown glass, apparently colored by iron.

It is probable that the mineral contains some titaniate, and that the blue color almost instantly assumed by the assay, is owing, as Kersten has shown, in the case of some of the titaniferous silicates, to the formation of blue oxide by the loss of oxygen in titanic acid.* Prof. Webster has the subject in hand for a chemical analysis, and he has taken measures to procure a larger supply from the locality.

PEROVSKITE.

This mineral has been named in honor of Von Perovski, of St. Petersburg, and according to M. G. Rose, (*Pogg. Ann.* xlviii. 558,) it consists principally of titanic acid and lime. It occurs in very small crystals, the primary form of which appears to be a cube. Specific gravity 4·071 ; Hardness 5·5. Color gray or iron-black ; opake ; has a metallic lustre. B B, it is infusible. With salt of phosphorous it shows the reaction of titanium, producing in the inner flame a grayish-green globule while hot, but which becomes of a violet-blue on cooling. In the outer flame, it is greenish-white while hot, but colorless when cold. It is found with magnetic iron ore in chlorite slate, at Achmatoosk, near Slatoust, in the Ural, and appears to be a very scarce mineral. Its near resemblance in crystalline form, hardness, and some of its pyrognostic characters, with the last described mineral, is interesting, and it is not improbable that both may prove to be essentially titaniate of lime.

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* See Lon. Edin. and Dub. Phil. Mag., xvii. 542, 1840.

BEAUMONITE OF M. LEVY.

This mineral recently identified with Heulandite, (see p. 39,) but which appears to be yet regarded as a new species in France, has now been analyzed by M. A. Delesse, (*Ann. de Chim. et de Phys.*, t. ix. p. 385, 1843.) The crystals selected for analysis, were of a honey-yellow color; their hardness was about that of apatite; specific gravity 2.24. They yielded as follows: silica 64·2, alumina 14·1, lime 4·8, magnesia 1·7, protoxide of iron 1·2, water 13·4, soda and loss 6=100. It appears to contain more silica than any of the zeolite species, and to the unusual proportion of this constituent, must be ascribed its superior hardness, and its capability of resisting the action of those acids, which readily decompose the ordinary zeolites.

This mineral, as a variety of Heulandite, presents an example analogous to that of the variety of chabasie, called Acadialite, in which the silica forms a larger atomic proportion, without causing any appreciable variation in the angles of the crystals. It otherwise comes very near to the analysis of a Heulandite by Retzius, (page 37,) if we unite the isomorphous bases which replace each other; and besides, both are characterized by the absence of the alkalies.

SISMONDINE.

This is a new mineral found by M. Bertrand de Lom, at St. Marcel, and named in honor of M. Sismonda, of Turin. It is of a deep green color, possessing great brilliancy; cleaves readily, affording highly lustrous laminæ; is brittle, and easily powdered, the color of the powder being bright greyish-green. Scratches glass; specific gravity 3·565. Its crystalline characters are not given. It does not affect the magnet either before or after calcination. It occurs in chlorite slate, and is accompanied by dodecahedral garnet and titaniferous iron. Its analysis by M. Delesse, afforded these constituents; (*Ann, de Chim. et de Phys.*, t. ix. p. 388, 1843):

Silica	24·1
Alumina	43·2
Protoxide of iron	23·8
Water	7·6
Trace of oxide of titanium	
	98·7

B B, it does not fuse, but becomes of a variable brown color. With salt of phosphorous it dissolves with difficulty, but when in powder, with great readiness. The globule is colored when hot, but becomes colorless on cooling. With borax the reaction of the iron is evident; with soda it melts with effervescence.

XANTHOPHYLLITE.

This mineral was first described by Prof. G. Rose, (*Poggendorf's Annalen*, i. 654.) It has since been analyzed by Meitzendorf, whose results, as given in Pogg. Ann., No. 1, 1843, are as follow :

Silica	17·05	16·55	16·41	16·29
Alumina	44·00	43·73	43.17	44·96
Lime	11·37	13·12	14·50	12·15
Magnesia	21·24	19·04	19·47	19·43
Protoxide of iron	1·91	2·62	2·23	2·73
Soda	0·61	0·67	0·62	0·55
Loss by ignition	4·21	4·33	4·45	4·33
	100·06	100·73	100·35	100·37

The formula supposes the bases to exist partly as silicates, and partly as aluminates, and is thus stated : $2R\ddot{S}i+6\dot{R}\ddot{A}l+\dot{R}\dot{H}^3$. Rammelsberg, (*Handwörterbuch, Supp.* 158,) has changed it to this expression, according to which it is a combination of Seybertite, or Clinlinite, and Gibbsite : $[3\dot{R}\ddot{S}i+\dot{R}$ $\ddot{A}l^2)+\dot{H}]+\ddot{A}l\dot{H}^3$. He seems, however, not to place full confidence in these formulas, while Rose, from its near resemblance in physical properties and in composition to Clintonite, as analyzed by Clemson, (see page 79,) is disposed to regard it as identical with that mineral. Clemson's analysis gives 6 per cent. less alumina. Xanthrophyllite occurs near Slatoust, in the Ural, in globular and columnar masses, of a foliated structure, readily cleavable, and possessing a pearly lustre. The internal structure sometimes develops tabular hexahedral prisms. It is of a lighter color than Clintonite, owing probably to its containing less iron, and its hardness is also a little inferior. The broad faces of the laminæ are readily scratched by apatite, while their edges plainly impress this mineral. B B, it does not melt, but becomes turbid and opake; with fluxes gives a greenish glass. It is decomposed by heated hydrochloric acid with great difficulty.

PUSCHKINITE.

This mineral from the western declivity of the Ural, was first examined and named by Wagner, (*Bulletin of the Imp. Society of Naturalists, Moscow,* 1841.) It occurs penetrating quartz, in long prismatic hexahedral and trihedral prisms, of a greenish color, resembling green tourmaline, for which it was at first mistaken; but it is distinguished from that mineral by its crystalline forms and several peculiarities, particularly by its dichroism, when viewed in different directions. Its specific gravity is 3·066, hardness 6·7. B B, it melts, *per se,* with difficulty and intumesces; is soluble in acids after it has been exposed to ignition. Its analysis afforded the following constituents: silica 38·385, alumina 18·850, peroxide of iron 16·340, oxide of manganese 0·260, lime 16·000, magnesia 6·190, soda 1·670, lithia 0·460 = 99·685.

M. Wagner has given the following formula: $3(\dot{C}a, \dot{M}g)\dddot{S}i+2(\dddot{A}l\dddot{F}e)\dddot{S}i$

M. Osersky[*] has endeavored to prove the identity of this mineral with epidote, or pistazite, (*dichromatic epidote of Breithaupt*,) and according to his observations, it agrees in hardness, and most of its external characters, and appears to belong to the same system of crystallization with that species. But he has not completed his examinations of it.

BAULITE.[†]

At the Scandinavian Society of Natural Philosophers in Stockholm, July, 1842, Forchhammer presented several new Icelandic minerals examined by him. Baulite is one of these, and occurs as a volcanic production in the mountain Baula. It was formerly brought from the volcano Viti, which belongs to the Krabla system, and was found to be of a white granular composition, and mixed with crystals of quartz, and a black mineral crystallized in long needles. It easily dissolves in hydrochloric acid. Specific gravity 2·623. Composed of silica 76·65, alumina 11·57, lime 0·05, magnesia 0·20, potash 3·26, soda 3·73, protoxide of iron 0·63. Formula: $(K, N)S^6 + 3AlS^6$. It is thus, as Berzelius observes, a kind of potash and soda-felspar, in which the bases are saturated with double as much silicic acid as in the common. It occurs frequently in the Iceland volcanic formations, and sometimes consists of a multitude of globular masses, outwardly somewhat reddish, but within white, with a concentric radiated structure. It is intermixed with, and held together by a mass of quartz.

PERICLASE.

M. Scacchi, Professor of Mineralogy at Naples, has given a description of a new mineral found in the ancient lava of Vesuvius, (*Ann. des Mines, fourth series*, vol. iii. 1843.) It is of a vitreous appearance, has an obscure green color, and confused crystallization, and is imbedded in a calcareous gangue like the Gehlenite of Fassa. It cleaves readily in three directions parallel to the faces of the cube, whence it derives its name, Periclase. It crystallizes in regular octahedrons, is infusible, B B. The powder is entirely soluble in acids. Hardness equal to felspar. Specific gravity 3·75. It is composed of magnesia and a little oxide of iron; 100 parts yielding, by the analysis of M. Damour, magnesia 92·57, oxide of iron 6·91, insoluble matter ·86 = 100·34.* Rammelsberg supposes this mineral to be substantially pure magnesia, of which a portion is replaced by protoxide of iron. It is thus very interesting, as showing the crystalline form of pure magnesia.

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[*] Transactions of the Imperial Russian Mineralogical Society, 1842, p. 66.

[†] Berzelius: Arsberättelse, for 1843, p. 189.

LEDERERITE.

A new examination of this mineral, described at page 214, is necessary, so far as to determine whether the phosphoric acid discovered in it by Mr. Hayes, is an essential and invariable constituent. A third visit to the locality having furnished no additional supply of crystals to enable the analyst to determine this point, we may be compelled to sacrifice the two or three very beautiful crystals that yet remain of it. Meanwhile, it is proper to add, that Berzelius has given a formula, founded on Mr. Hayes' analysis, according to which the mineral appears to consist of three atoms lime-analcime, united with one atom phosphate of lime, as thus expressed:†

$$3\left(\left.\begin{matrix}\dot{Ca}^3\\ \dot{Na}^3\end{matrix}\right\}\dddot{Si}^2+3\dddot{\bar{A}}l\dddot{Si}^2+6\bar{H}\right)+\left(Ca\left\{\begin{matrix}\bar{C}l\\ \bar{F}l\end{matrix}\right.+3\dot{Ca}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}\right.$$

To suppose the mineral a variety of chabasie or Gmelenite, requires three times the quantity of water above stated.‡ May not this mineral be viewed as a fixed combination of three atoms lime-analcime, one atom phosphate of lime, and the change in crystalline form to a hexahedral prism, be attributed to the influence of the phosphate of lime which always occurs in this form? The cleavage parallel to the faces of this prism, opposes its union with chabasie.

SODA SPODUMENE.

Natron Spodumen. Oligoclas.

This mineral occurs in granite, at Danvikszoll, near Stockholm, and at Arendal and Arriège, in Sweden; also in the Ural. It is accompanied by calc-spar, quartz, mica and felspar; and at Clausthal it is found in serpentine. According to Breithaupt, its primary form is an Oblique rhombic prism, P on M, 93° 45′, P on T, 115° 30′. Its cleavage is very distinct parallel with P. Color white, yellowish, and greenish-white. Lustre of planes P, between vitreous and pearly; the other faces greasy. Translucent to transparent. Fracture conchoidal. Specific gravity 2·64—2·67. Hardness 6. B B, it fuses with difficulty; and it is not acted upon by acids. Its analysis by Berzelius,* Hagen,† and Laurent,‡ gave the following results:

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* From the Am. Jour. of Sci., xlvi. 213. † Jahres-Bericht, xiv. 175.

‡ A writer in the Lon. and Edinb. Phil. Journ., (iv. 394) has supposed it to be identical with Gmelenite, and Dana has arranged it under the same species.

	Danvikszoll.		Arriège.	Atoms.	
Silica	63·70	63·51	62·6	31·65	
Alumina	23·95	23·09	24·6	10·64	
Peroxide of iron	0·50	0·00	0·1	10	
Lime	2·05	2·44	3·0	58	3·03
Magnesia	0·65	0·77	0·2	22	
Soda	8·11	9·37	8·9	2·03	
Potash	1·20	2·19	0·0	20	
	100·16 Berzelius.	101·37 Hagen.	99·4 Laurent.		

It is evident that the constitution of this mineral, as shown by the atomic numbers in the last column from Berzelius' analysis, is three atoms bisilicate of alumina, one atom tersilicate of the other bases. Formula: $3AlS^2+(Cal, Mg, N, K)S^3$.

ERINITE.§

This mineral occurs in the amygdaloid rocks near the Giant's Causeway. It has been examined and analyzed by Dr. Thomson, who named it from Erin, the name by which Ireland is known in the native language of the country. Its color is yellowish-red. It is compact, very fine grained; opake; with a resinous lustre, and a soapy feel. Fracture conchoidal. Hardness 1·75. Specific gravity 2·04. When heated it gives out about one-fourth its weight of water. B B, it whitens, but does not fuse; with carbonate of soda fuses with effervescence into a blebby glass; with borax into a transparent colorless glass; with biphosphate of soda into an opake white frit.

Its constituents were found to be as follow: silica 47·036, alumina 18·464, lime 1·000, protoxide of iron 6·360, magnesia a trace, water 25·280, common salt 0·900 = 99·040.

The salt was accidental and derived from the sea. By uniting the lime to the alumina, Dr. Thomson makes the constitution of this mineral (admitting a slight excess of silica) as thus stated: $6AlS^2+\underline{F}S^4+16Aq$.

Erinite resembles in composition one or two varieties of bole,

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[*] Jahres-Bericht, iv. 147.

[†] Ann. de Chim. et de Phys., lix. 108.

[‡] Pogg. Ann., xliv. 329.

[§] Dr. Thomson's Outlines, &c., i. 341.

particularly those from Striegau in Silesia, and Stolpen—t first consisting of 42·00 S., 20·12 Al., 8·53 F., 2·81 Cal., 2·1 Mg., 24 Aq. = 99·47: the last of 45·922 S., 22·145 Al., 3·9 Cal., 25·860 Aq. = 97·829.*

WICHTYNE.

This mineral from Wichty, in Finland, first recognised b M. Nordenskiold, afforded by the analysis of M. Laurent *(An de Chim. et de Phys.,* lix. 111,) the following results: silic 56·3, alumina 13·3, peroxide of iron 4·0, protoxide of iron 13, lime 6·0, magnesia 3·0, soda 3·5 = 99·1.

It consists of one atom bisilicate of alumina and peroxide o iron, with one atom bisilicate of the other bases. Formula: $(\mathrm{Al}\underset{\cdot}{\mathrm{F}}\mathrm{e})\mathrm{S}^2+(\mathrm{N}, \mathrm{Ca}, \mathrm{Mg}, \underline{\mathrm{F}})\mathrm{S}^2$.

Its color is black, fracture flat conchoidal. It possesses cleavages which are obtained with difficulty, indicating a rectangular rhomboidal prism for its primary. It scratches glass; is fusible B B, into a black enamel. With borax into a greenish pearl. It is attracted by the magnet. Specific gravity 8·03. It gives out water before calcination, and is not acted upon by acids.

SAPONITE.

M. Svanberg. (*Royal Swedish Academy's Transactions*, 1840, p. 153.)

This is a mineral which has much resemblance in its external characteristics to soapstone. It occurs in Svaerdsjoe parish in the Dales, among the deserted mines of Brucksved, and also in those of Svartvik. In the latter it is found in clefts of not more than two inches thickness, and when taken out in a wet state, is so soft that it may be spread like butter; so that some of the miners tried to eat it as a substitute for butter at first, but found it something very different. In the air it hardens gradually, but falls to pieces in drying, and the pieces become a soft powder. After drying and hardening in the air, it has about the hardness of talc, so that it may be easily scratched with the nails. In water it falls to pieces quickly. It is dissolved by muriatic acid when heated, and decomposed by sulphuric acid when cold, though very slowly. The mineral is partly colorless, and partly inclining to yellow and red. It is altogether without cleavage, and compact. Fracture slightly lustrous, streak lustrous. To the feel greasy; does not adhere to the tongue; is slightly translucent.

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* Rammelsberg's Handwörterbuch, i. 145.

It gives out abundant water, with a portion of bitumen. It melts by itself in thin splinters to a white blistery enamel. It is dissolved by borax; but leaves, with salt of phosphorous, a skeleton of silicic acid undissolved. It fuses with soda to an opake glass. Compared with soapstone from Cornwall, B B, the latter fuses more easily by itself, as well as with soda.

M. Svanberg found the composition of a specimen from Brusksveden, as follows: silica 50·8, alumina 26·5, lime 0·7, magnesia 9·4, peroxide of iron 2·0, water 10·5 = 99·9.

The mineralogical formula deduced from this analysis is: $2MgS^2+AlS+2Aq$. Or changed to the chemical it becomes, $2\dot{M}g^3\ddot{S}^2+\ddot{A}lS+6\text{Ħ}$. The water actually contained in the mineral was 24 per cent., but 14 per cent. was mechanical and escaped in drying. This composition can in no way be deduced from either of the analyses obtained from Cornwall soapstone; and Svanberg has examined anew the English soapstone, and found its composition very different. He has named it saponite from the Latin for soap. The mineral with which the saponite, in chemical respects, most nearly agrees, is that analyzed and described by Pfaff, under the name of Kerolith, and which originates from Toblez, in Saxony.

DREELITE.

This mineral, named in honor of M. de Drée, occurs in a lead mine at Nuisière, in the environs of Beaujeu, in France. The following description of it has been drawn up by M. Dufrénoy *(Ann. de Chim. et de Phys.*, lx. 102.*)* It occurs in small rhomboidal crystals, of a pearly lustre, and without any modifications. It presents three cleavages parallel with the faces of its primary, an Obtuse rhomboid, P on P′ 93° or 94°. These cleavages are also indicated by the fractured surfaces which are parallel with them. In its external characters it resembles chabasie. Streak and color white. Specific gravity 3·2—3·4; hardness 3·25. B B, it fuses into a white blebby glass, which is colored blue by nitrate of potash.

The following are the results of its analysis by M. Dufrénoy: sulphate of barytes 61·731, sulphate of lime 14·274, lime in excess 1·521, carbonate of lime 8·050, silica 9·712, alumina 2·404, water 2·308 = 100.

The only essential constituents are supposed to be the two first named; and it is thus a baryto-calcite, consisting of two atoms sulphate of barytes, one atom sulphate of lime. Formula: $2Br\dot{S}+Cal\dot{S}$. It differs essentially from the baryto-calcite of Dr. Thomson, which consists of four and a half atoms su phate of lime, one atom sulphate of barytes: or 71·9 sulphat of lime, 28·1 sulphate of barytes.

POLYSPHÆRITE, HEDYPHAN, AND NUSSIERITE.

Frankenheim *(System der Krystalle,* p. 523,*)* has unit the two first minerals named by Breithaupt, and the last Danhauser, and comprises them under this formula: $3(\dot{\mathrm{Pb}}, \dot{\mathrm{C}}$ $^{3}(\overset{\cdot\cdot\cdot\cdot\cdot}{\underline{\mathrm{P}}}, \overset{\cdot\cdot\cdot\cdot\cdot}{\underline{\mathrm{A}}}\mathrm{s})+\mathrm{Pb}, \mathrm{Ca})\underline{\mathrm{F}}, \underline{\mathrm{C}}\mathrm{l})$.

COMPTONITE.

Rammelsberg has analyzed this mineral, and shown that it identical in composition with Thomsonite. Its near agr ment in crystalline characters, and in other respects, is in co firmation of his result. His analysis was not observed in s son to be given under the description of Comptonite, p. 21 It is as follows, the specimen being from Seeberg, in Bohemi silica 38·735, alumina 30·843, lime 13·428, soda 3·852, pota 0·542, water 13·097. The chemical formula, according Rammelsberg, is: $(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}}, \dot{\mathrm{K}})^{3}\dddot{\mathrm{Si}}+3\dddot{\mathrm{Al}}\dddot{\mathrm{Si}}+7\dot{\underline{\mathrm{H}}}$. The spe men analyzed by Dr. Thomson, came from Vesuvius, and he was unable to employ but 7·25 grains of it, he supposes l analysis imperfect.

PHILLIPSITE, OR LIME HARMOTOME.

Arthur Connell, Esq., has analyzed this mineral from tl Giant's Causeway, (*Jameson's Edinb. Phil. Journ.*, 1843, 376,) and obtained results which give a somewhat differe formula from that deduced from former analyses of crysta elsewhere selected. He obtained silica 47·35, alumina 21·3 lime 4·85, potash 5·55, soda 3 7, water 16·96 = 100·21. Fo mula: $2(\mathrm{Cal}, \mathrm{K}, \mathrm{N}(\mathrm{S}^{2}+6\mathrm{AlS}^{2}+9\mathrm{Aq}$.

EXPLANATION OF TERMS

USED IN

MINERALOGICAL DESCRIPTIONS.

Acicular. Long, slender, and straight prisms, or crystals, are termed acicular, from the Latin, *acicula*, a little needle.

Aggregated. A mineral or rock is said to be aggregated when the several component parts only adhere together, and may be separated by mechanical means: the felspar, quartz, and mica, constituting granite, may be separated mechanically. Granite is an aggregated rock.

Alliaceous. The odor given out by arsenical minerals, when exposed to the blowpipe or struck by the hammer, resembled that of garlic, in Latin, *allium;* whence alliaceous.

Alloy. A natural combination of two or more metals in the metallic state.

Amalgam. A natural combination of two metals, of which mercury is one.

Amorphous. Without form; of undefinable shape; from the Greek, αμορφος having that signification. Amorphous minerals are sometimes described as being of indeterminate or indefinite forms.

Anhydrous, from the Greek ανυδρος, signifying without water.

Arborescent, from the Latin arboresco, to grow like a tree. See *Dendritic.*

Arseniate. A term applied to a mineral consisting of *arsenic acid* united with a base.

Base. A term denoting the substance to which an acid is united. In the arseniate of copper, the copper is the base.

Borate. A mineral in which boracic acid is combined with a base.

Botryoidal. From the Greek βοτρυωδης, signifying hung with clusters of grapes or berries. So a mineral presenting an aggregation of large sections of numerous small globes is termed botryoidal; but when the globes are larger, and the portions are less and separate, the appearance is expressed by the term mammillated. These forms may be observed in certain ores of cobalt, copper, and manganese, and often in calcedony.

Brittle. This character of mineral bodies does not depend upon their hardness; those of which the particles cohere in the highest degree, and are immovable one among another, are the most brittle. The diamond, quartz, sulphate of barytes, and sulphur, vary greatly as to hardness; they are all brittle, the first only in particular directions.

Capillary, derived from the Latin *capillus*, a hair, is chiefly used to express the long, tortuous, hair-like appearances observable in native gold, silver, and some other minerals. Crystals are sometimes termed capillar when long and slender; but when also straight, they are more proper designated acicular.

Carbonate. A mineral in which carbonic acid is combined with a base

Cellular. This term was used by Werner in the description of suc minerals as exhibit cells formed by the crossing and intersecting of th lamellæ of which they are constituted; commonly, any mineral present ing numerous small cells or cavities is termed cellular. See vesicula

Chatoyant has been adopted from the French, who use it to express th changeable light resembling that observable in the eye of a cat, exhib ited by certain minerals

Chromate, a mineral in which chromic acid is united with a base.

Cleavage. This term is most commonly used in relation to the fracture those minerals which, having natural joints, possess a regular structure and may be cleaved into more or less geometrical fragments: as, in t varieties of the parallelopiped, the rhomboid, &c.

Coherent. In minerals that are brittle, the particles are strongly cohe rent; in such as are friable they are slightly coherent.

Columnar distinct concretions; a term used to express the great an small columns in which certain iron ores and other minerals are found

Compact. A mineral is compact when no particular or distinct parts a discernible; a compact mineral cannot be cleaved or divided into regu lar or parallel portions. It is too often confounded with the term massive

Concentric lamellar. This relates to structure, and is used in the descrip tion of such minerals as, being of a spherical form, have received suc cessive coatings or depositions. An onion cut in two exhibits the con centric-lamellar appearance in perfection.

Conchoidal relates only to fracture, and is derived from the Latin *con choides*, signifying like a shell. Many of the brittle minerals exhibi this appearance, and occasionally in great perfection, as quartz, sul phur, anthracite, &c.

Concretion generally signifies a small and distinct mass.

Coralloidal, resembling branches of coral.

Cuneiform, wedge-shaped; *cuneus*, in Latin, signifies a wedge.

Decomposed. This term, when used strictly in a mineralogical sense imports the consequence of the chemical action which takes place natu rally in some minerals. Certain ores of iron, &c. in which sulphur pre dominates in an unusual degree, decompose by exposure to air.

Decrement. This term relates to structure. See p. xlix.

Decrepitate. A mineral is said to decrepitate on exposure to heat when it flies with a crackling noise similar to that made by salt when thrown into the fire.

Dendritic, derived from the Greek δενδριτης, signifying, like the growth of a tree. The terms arborescent and dendritic are used synonymously: they are alike applied to the tree-like appearance in which native silver and native copper are sometimes found; to the delineations seen on the surfaces of certain minerals; to the appearance in the mocha-stone, &c.

Dentiform, in the shape of teeth; *dens* being the Latin for a tooth.

Dimorphous. See p. lxxxiv.

Disseminated. When a mineral, whether crystallized or otherwise, is found here and there imbedded in a mass of another substance, it is said to be disseminated in the mass.

Disintegrated is generally used to express the falling to pieces of any mineral, without any perceptible chemical action.

Diverging, or *Divergent.* When the structure is fibrous, and the fibres are not parallel, they usually diverge in part, but not wholly, around a common centre; as is in certain zeolites, and hæmatitic irons. The crystals of some substances assume a diverging position.

Drusy has been adopted from the German term *drusen*, for which we have no English word. The surface of a mineral is said to be drusy when composed of small prominent crystals, nearly equal in size; it is often seen in iron pyrites.

Efflorescence is the consequence of chemical action; it is applied to such minerals as are found in extremely minute fibres on old walls, &c.

Elastic. A mineral which, after being bent, springs back to its original form, is elastic. Mica is elastic; talc, which greatly resembles mica, is only flexible.

Earthy. This term relates to fracture and to texture. Chalk, and certain of the ores of iron and lead, are notable instances of the earthy fracture or texture.

Emarginated. Crystals are said to be emarginated when the edges of their primary forms are each truncated by one face.

Fasciculated. When a number of minute fibres or acicular crystals occur in small aggregations or bundles, they are said to be fasciculated; from the Latin *fasciculus*, a little bundle.

Fibrous. This term relates both to form and structure. Certain minerals, as amianthus, gypsum, &c., occur in distinct fibres. Asbestus, red hæmatite, &c., are found massive, and present a parallel fibrous structure; others are of a radiating fibrous structure, when the fibres diverge from a common centre.

Filament. A mineral is said to occur in filaments when it is found in slender thread-like or hair-like portions. It is therefore nearly synonymous with the term capillary.

Filiform is used in the same sense as the preceding, but Werner employed it to express the appearance of certain metals which occur in the form of wire, as native silver and native copper. *Filum*, in Latin, signifies thread; *filum metalli*, wire.

Flexible. Talc is flexible; it readily bends, but does not return of itself to its original form. Mica is both flexible and elastic.

Fluate. This term designates a mineral in which fluoric acid is combined with a base.

Foliated. This term, from the Latin *foliatus*, having or consisting of leaves, is used by Werner to express the structure of all minerals that may be divided or cleaved regularly, and are therefore by him said to consist of folia or leaves. The structure of such minerals is more commonly and better expressed by the term lamellar; and they are said to consist of laminæ.

Fracture is a term chiefly employed in designating the appearance of minerals which have no regular structure when they are broken; such minerals present an earthy, even, uneven, or conchoidal fracture, &c.

Frangible. This term relates to the susceptibility of minerals to separate into fragments by force; it is a quality not dependent on hardness; the structure of some, and the brittleness of other minerals, render them easily frangible; while many, from their softness, and the ease with which their particles or molecules yield or slide over one another, are much more difficultly frangible; these possess the character of toughness; Quartz is easily broken; asbestus is tough.

Friable. A mineral whose portions or particles slightly cohere, and which is therefore easily crumbled or broken down, is said to be friable.

Fungiform. Certain substances, as, for instance, calcareous stalactites, are occasionally met with, having terminations similar to the head of a fungus; whence the term.

Gangue, from the German. The gangue or matrix is the substance in upon which a mineral is found.

Geode. This also is derived from the German; a geode is a hollow ball, generally lined with crystals.

Glance is a German word, meaning shining; thus, glance-coal, copper-glance, &c.

Globular distinct concretion is used to designate the form of any mineral which occurs in small round or roundish masses: pea-stone and roe-stone are examples of it.

Granular. The structure of a mineral is said to be granular when it appears to consist of small grains, or concretions, which sometimes are, sometimes are not, discernible; we have therefore the fine granular and the coarse granular structure.

Greasy is used in relation to lustre.

Hackly. This term relates to a fracture which is peculiar to the malleable metals; which, when broken, present sharp protruding points.

Hæmatite is derived from the Greek αἱματίτης, signifying *blood-red*. It was first applied to the variety of iron ore which is called red hæmatite, but has since been extended to other iron ores of the same structure, but differing in color.

Hepatic, from the Latin *hepar*, the liver: it is applied either to color o form.

Hydrate is derived from the Greek ὕδωρ, water; and is applied to thos minerals of which water forms an ingredient in large proportion.

Imbedded. A mineral found in a mass of another substance is said to b imbedded in it.

Incrusted. Any substance covered by a mineral is said to be incruste by it.

Interlacing. When fibres or crystals of a mineral are found intermingling with each other in various directions, they are said to be interlacing.

Investing. A mineral coating or covering another is sometimes describe as investing it.

Iridescent. This term relates only to the color with which the surface of some metallic species are naturally tarnished.

Irisated. A mineral is described as irisated which exhibits the prismati colors either externally or internally: the latter is generally the consequence of some injury sustained by the mineral.

Isomorphism. See p. lxxxii.

Lamellæ, *Lamellar*, relate to structure. When a mineral can be fractured or cleaved into regular and parallel plates, its structure is said to be lamellar; and the portions thus obtained are termed laminæ or lamellæ. These terms have been adopted from the Latin, in which they were almost synonymously used to express thin plates of any substance.

Lamellar distinct concretions. This is used to denote the form of certain minerals consisting of separate tabular crystals.

Lamelliform. A mineral consisting of lamellæ is said to be lamelliform.

Lenticular is employed to express the forms of certain crystals which are nearly flat, and convex above and beneath; and which consequently resemble a common lens.

Malleability. Some of the metals suffer extension when beaten with a hammer, and are therefore termed malleable metals. Native gold and native silver are very malleable metals.

Mammillated. See *Botryoidal*.

Massive. This term is sometimes used in describing a substance of indeterminate form, whatever may be its internal structure; but is more commonly applied to those minerals which possess regular internal structure, without any particular external form.

Matrix. See *Gangue.*

Meagre. This term relates to the touch or feel of a mineral. It belongs chiefly to some of those species which possess an earthy texture. Chalk is remarkably meagre to the touch.

Natural joints. Such minerals as can be broken into regular forms, as the cube, rhomboid, &c. are cleavable into those forms only in the direction, of or along their natural joints. In some species these natural joints are perceptible by the assistance of a strong light.

Nacreous relates to lustre, and is employed to express the lustre of some minerals which greatly resembles that of pearl.

Nodular. A mineral which presents irregularly globular elevations is termed nodular.

Opake. Those minerals are opake which do not transmit a perceptible ray of light even through the thinnest and smallest pieces.

Pass into. One mineral is said too pass into another, when both are found so blended in the same specimen that it is impossible to decide where the one terminates and the other begins. Flint is found passing into calcedony.

Plumose. Resembling a feather.

Porous. A mineral is said to be porus when it is traversed in different directions with communicating holes which pass through the substance.

Pseudomorphous. Minerals exhibiting impressions of the forms peculiar to the crystals of other substances are said to be pseudomorphous. Ψευδος, in Greek, signifies false ; μορφη, form or figure. See p. lxxx.

Pulverulent. When the particles of a mineral are minute, and cohere very slightly, or not at all, it is said to be pulverulent, or in the pulverulent state.

Radiated. Radiatus, in Latin, signifies beset with rays. When the crystals of a mineral are so disposed as to diverge from the centre, they are said to be radiated.

Ramose. Ramus, in Latin, signifies the branch of a tree. A mineral having that appearance is described as being ramose.

Refractoriness. This term is used both chemically and mechanically in relation to minerals. It is sometimes applied to those which strongly resist the application of heat, and occasionally to some whose toughness enables them to resist repeated blows.

Reniform, kidney-shaped. *Ren,* in Latin, signifies kidney.

Reticulated. Minerals occurring in parallel fibres, crossed at right angles by other fibres which also are parallel, exhibit squares like the meshes of a net. *Retis,* in Latin, signifies a net.

Schistose or *slaty structure.* Minerals which split only in one direction, and present fragments which are parallel, but of unequal thickness, which also are not smooth and even, and are without lustre, are said to possess a schistose structure.

Scopiform. If a number of minute crystals or fibres be closely aggregated into a little bundle, with the appearance of diverging slightly from a common centre, they are said to be scopiform. *Scopa,* in Latin, signifies a broom or besom.

Sectile. The term sectile is derived from the Latin *seco,* to cut. Those minerals are termed sectile which are midway between the brittle and the malleable. A slice or portion cut from a sectile mineral is fragile, and the new surface on the mass is smooth and shining.

Semi-transparent. A mineral is said to be semi-transparent when an object is not distinctly seen through it.

Specular Minerals are those which present a smooth and brilliant surface which reflects light. *Speculum*, in Latin, signifies a looking-glass.

Splintery fracture belongs to imperfectly crystalline minerals.

Stalactitiform. Σταλάγμα signifies a drop, an icicle, which stalactitiform minerals greatly resemble in shape.

Stalagmite. A stalagmite is the deposition afforded by the water dropping from a stalactite, as on the floor of a cavern.

Stellated. When the crystals or fibres of a mineral diverge all round a common centre, it is said to be stellated. *Stella*, in Latin, signifies a star.

Striæ, *Striated*. The slight channels occasionally observable on the planes of crystallized minerals are termed striæ, and the crystals which exhibit them are said to be striated. The Striæ are commonly parallel, and generally indicate the direction in which crystals may be cleaved. *Stria*, in Latin, signifies a groove or channel.

Sulphuret. A metallic mineral in which the metal is combined with sulphur. In these minerals the metal is not in the state of an oxide, but in the metallic state.

Supernatant. Such minerals as are lighter than water, and consequently swim upon it, are said to be supernatant; from the Latin.

Tabular. When this term is used in relation to structure, it is nearly allied to the schistose or slaty. It is used more generally to express the external form of such crystals as are nearly flat; these are termed tabular crystals; from the Latin *tabula*, a table.

Toughness relates to internal texture. Those minerals which are bruised or suffer depression by repeated blows in the attempt to fracture them, are esteemed to be tough.

Translucent. A mineral through which an object cannot be seen, but which transmits some light, is termed translucent. Many minerals are translucent only on the edges.

Transparent. Those minerals are transparent through which an object may be clearly seen.

Tubercular. A mineral whose unevenness of surface arises from small and somewhat round elevations, is said to be tubercular.

Unctuous. This term relates to the touch. Plumbago and soapstone are very unctuous.

Vesicular. A mineral is said to be vesicular when it has small and somewhat round cavities, both internally and externally. Lava, pumice, limestone, &c., are sometimes vesicular. From the Latin, *vesicula*, a little bladder.

Vitreous. Minerals having the lustre of glass are said to possess the vitreous lustre.

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ERRATA.

Preface, p. ii, line 13, for "multiplied by ten" read "multiplied by 100."

Page xliv, note, for "calcarcons" read "calcareous."
" cxxxv, Sp. 29, substitute this formula: "$\text{Cal}\dot{C}+\text{Br}\dot{C}$."
" cix, second line, substitute "8·5" for "85."
" cxxix, Sp. 61, substitute "$4\text{Cal}^2S+\text{Mg}S^2$" for "$4CS^2+MS^2$."
" cxxxiii, for the formula for Haydenite, substitute this: "$2(\text{Al}, \underline{F})S^3+(K, \text{Cal}, \text{Mg},)S+2\text{Aq}$."

Page 73, note, for "analyses" read analysis."
" 90, line 1, for "characterizes" read "characterized."
" 122, line 1, for "$4CS^2+MS^2$" read "$4\text{Cal}S^2+\text{Mg}S^2$."
" 136, line 2, for "Pleonate" read "Pleonaste."
" 165, line 7 from bottom, for "trapozoidal" read "trapezoidal."
" 171, for "H" in the formula for Poonahlite substitute "$12\dot{H}$."
" 207, in the formula for Gigantholite, for "F, M," read "$\underline{F}$, $\underline{M}$n."
" 242, line 7, above article Phakolite, for "basis" read "bases."
" 293, line 5 from the figure, for "their" read "these."
" 324, line 2, for "borax" read "soda."
" 333, line 1, in art. Soda-Alum, for "analyses" read "analysis."
" 344, make the same correction as above in the note to this page.
" 484, line 4 from bottom, for "pounds" read "puds."
" 553, fourth analysis, place the figures "40·293" against molybdic acid, and "61·903" against protoxide of lead.
" 605, formula, line 3 from bottom substitute "$\underline{F}$" for "F."
" 617, formula for Pickeringite, place a dot over the "$\underline{M}$."
" 619, ine 12, for "lamenated" read "laminated."
" 619, line 18, for "Salamoniac" read "Salammoniac."
" 698, line 19, for "Clinlinite" read "Clintonite."
" 642, add "Anhydrous Silicate of Alumina, p. 109."
" 644, add "Bucholzite, p. 109."
" 648, add page 109 to "Epimecius Bucholzianus."